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DELAWARE RIVER BASIN. ZONE 4. A COOPERATIVE STATE-FEDERAL REPORT ON WATER POLLUTION CONTROL

Public Health Service
New York, New York

April 1953

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DELAWARE RIVER BASIN

ZONE 4

A Cooperative State-Federal Report on Water Pollution Control

DELAWARE
Water Pollution Commission
State Board of Health
NEW JERSEY
Department of Health
PENNSYLVANIA
Sanitary Water Board
Department of Health
THE INTERSTATE COMMISSION
ON THE DELAWARE RIVER BASIN

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U.S DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service
North Atlantic Drainage Basins

87

REPORT ON WATER POLLUTION CONTROL

DELAWARE RIVER BASIN - ZONE 4

Prepared by

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
Public Health Service

Division of Water Pollution Control
North Atlantic Drainage Basins Office

April 1953

Details of illustrations in
this document may be better
studied on microfiche.

In cooperation with the:

Delaware Water Pollution Commission
Delaware State Board of Health
New Jersey State Department of Health
Sanitary Water Board, Pennsylvania Department of Health
Interstate Commission on the Delaware River Basin

Public Health Service Publication No. 295

II

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INTRODUCTION

The Federal Water Pollution Control Act, Public Law 845, passed by the 80th Congress in June of 1948, provided for full recognition of the primary responsibilities and rights of the States in controlling water pollution. It requires the Surgeon General of the Public Health Service to cooperate with other Federal agencies, with State and interstate water pollution control agencies, and with municipalities and industries in the preparation or adoption of comprehensive programs for eliminating or reducing the pollution of interstate waters and tributaries thereof, and improving the sanitary condition of surface and underground waters.

In developing these programs, due regard must be given to improvements necessary to conserve the Nation's waters for public water supplies, propagation of fish and aquatic life, recreational purposes, agricultural, industrial, and other legitimate uses.

As a first step in carrying out this requirement, the data available as of July 1, 1950, were presented in summary type reports covering the major drainage basins in the United States, the data concerning the Delaware River Basin being presented briefly in the summary report on the North Atlantic Drainage Basins.

The summary report considered the water pollution problems of the Delaware River Basin as a whole. This report contains pollution data available as of April 1953 and relates to water pollution control measures in Zone 4 of the Delaware River Basin.

Water pollution control in this region has been given considerable study by the water pollution control agencies of the four States of New York, New Jersey, Pennsylvania and Delaware charged with this administrative responsibility, and the Interstate Commission on the Delaware River Basin (Incodel), a joint cooperative agency maintained by the four states.

Pollution control activities of these agencies of the States are supported by their respective State laws relating to intrastate water pollution and the Incodel laws which have been passed by each of the States in the form of reciprocal legislation for the control of the interstate Delaware River and its tributaries.

The Incodel laws enacted, New Jersey - Chapter 146, July 1, 1939; New York - Chapter 600, May 31, 1939; Delaware - Chapter 93, May 8, 1941; and Pennsylvania - Chapter 123, April 19, 1945; provide for the minimum degree of treatment of wastes discharged in each of four zones of the Delaware River Basin.

ZONE 1: Zone 1 is that part of the Delaware River and its West Branch extending from the New York-Pennsylvania boundary line to the head of tidewater at Trenton, New Jersey and Morrisville, Pennsylvania.

The drainage basin contributory to this zone, excepting part of the Lehigh River Basin, is relatively sparsely inhabited and contains few sewered communities and relatively few industrial establishments producing waste water. The streams draining this area being, in general, relatively clean and of high elevation, are well adapted as sources of public water supplies, after treatment or purification.

The principal uses of the waters of the Delaware River in Zone 1 are expected to be for water supply after such treatment or purification as may be necessary, and for recreation, bathing, maintenance of fish and aquatic life, agriculture, and for other related purposes.

ZONE 2: Zone 2 is that part of the Delaware River extending from the head of tidewater at Trenton, New Jersey and Morrisville, Pennsylvania to a line drawn perpendicular to the channel of the Delaware River from the mouth of Pennypack Creek in Philadelphia, Pennsylvania, to the corresponding point on the New Jersey shore.

The drainage basin contributory to this zone is somewhat more densely populated than that of Zone 1, and it contains more sewered communities and industrial establishments.

The principal uses of the waters of the Delaware River in Zone 2 are expected to be for water supply, after treatment or purification, and for recreation, navigation, maintenance of fish and aquatic life, agricultural, industrial and other purposes.

ZONE 3: Zone 3 is that part of the Delaware River extending from the aforesaid line connecting the mouth of Pennypack Creek in Philadelphia and the corresponding point in New Jersey to the Pennsylvania-Delaware boundary line.

The drainage basin contributory to this zone contains populous metropolitan areas including Philadelphia, Pennsylvania and Camden, New Jersey.

The principal uses of the waters of the Delaware River in Zone 3 are expected to be for navigation, industrial water supply, and other purposes.

The water in this zone, however, should be of such sanitary quality that it will not be unfit for use as sources of water supply, will not be harmful to fish life, and will not adversely affect the quality of the waters of the tidal tributaries.

ZONE 4: Zone 4 is that part of the Delaware River extending from the Pennsylvania-Delaware boundary line to the Atlantic Ocean.

The principal uses of the waters of the Delaware River in Zone 4 are expected to be for navigation, industrial water supplies, commercial

fishing, shellfish culture, recreation and other purposes.

This report describes the status as of April 1953 of the comprehensive water pollution control programs conducted by the Delaware Water Pollution Commission, the New Jersey State Department of Health, the Sanitary Water Board of the Pennsylvania Department of Health and the Interstate Commission on the Delaware River Basin (Incodel) in that portion of the drainage area contributory to Zone 4 of the Delaware River Basin. It sets forth information about the ways the water resources of the area are used, the pollution entering those water resources and the resulting damages, the benefits which may result from pollution prevention and abatement, pollution prevention measures in effect, and those which appear to be needed. Its scope is limited to surface water pollution control. Ground water pollution has not been considered in the report although usage of ground water is mentioned. While it is true that additional information is needed to complete the program, the objectives have been established and general plans for attaining them have been adopted by the States and Incodel. The program is well advanced with the major portion already completed in most of the Pennsylvania section and aimed toward completion by 1955 in Delaware and New Jersey.

The data on which this report is based have been compiled through and in cooperation with the Delaware Water Pollution Commission and State Board of Health, the New Jersey State Department of Health, the Sanitary Water Board of the Pennsylvania Department of Health, and the Interstate Commission on the Delaware River Basin. Through these agencies additional data have been obtained from other State officials, municipal officials, and representatives of industry. Federal agencies also have cooperated.

The detailed data and remarks relating to individual sources of pollution appearing in Basic Data Tables 1 and 2, are the determination of the State water pollution control agencies and are included to illustrate the status of the program as of April 1953.

Comprehensive programs for pollution control must necessarily be fluid. They must allow for growth, development and changing conditions. The program now in effect in this area appears to fit the current needs. Reappraisal in the course of time will provide for adjustments as the need arises.

A sincere effort has been made by all who contributed to this report to present a fair picture of the complex water pollution problems in the Delaware River Basin - Zone 4, and to present reasonable conclusions and recommendations. It is our hope that this report will help in safeguarding the water resources in this area.

ACKNOWLEDGMENTS

The Public Health Service wishes to acknowledge the cooperation and assistance of those agencies and individuals that have contributed to the preparation of this report.

The Delaware Water Pollution Commission and State Board of Health, the New Jersey State Department of Health, and the Sanitary Water Board in the Pennsylvania Department of Health, have furnished the data from which the various tables were prepared and other data and information contained in the narrative statements. The Interstate Commission on the Delaware River Basin also supplied considerable data and assisted in drafting portions of the report. These agencies have, in addition, reviewed the preliminary draft of the report and offered valuable comments and suggested changes. In general, the preliminary draft has been revised so that this report is in agreement with the comments and suggestions of the participating State and interstate agencies.

Federal agencies from which assistance was obtained include the Corps of Engineers, Department of the Army; the Geological Survey, Fish and Wildlife Service and Bureau of Mines, Department of the Interior; the Department of Commerce; the Department of Agriculture; and the Federal Power Commission. The report was reviewed and cleared by the Federal Inter-agency River Basin Committee.

Finally, there is acknowledged the assistance of other State and Federal agencies and individuals interested in water resources development and conservation that have contributed information through other sources than those listed above.

SUMMARY

The area known as Zone 4 of the Delaware River is that part of the Delaware River and Bay extending from the Pennsylvania-Delaware boundary line to the Atlantic Ocean. The drainage area contributory to this section is approximately 2434 square miles excluding the surface area of Delaware Bay. It is divided entirely among the States of Delaware, New Jersey, and Pennsylvania, except for eight square miles that extend into Cecil County, Maryland. This region, which comprises about 19 percent of the drainage area of the entire Delaware River Basin, includes the major portions of New Castle and Kent Counties and part of Sussex County in Delaware; the whole of Salem County, almost all of Cumberland County and sections of Cape May, Gloucester, and Atlantic Counties in New Jersey; and about half of Chester County and small segments of Delaware and Lancaster Counties in Pennsylvania.

The population of the area is approximately 497,000, an increase of about 19.5 percent since 1940. Of this population, about 210,000 reside in the Wilmington-New Castle County area of Delaware. Within the 12 counties wholly or partially in Zone 4 there are numerous political sub-divisions including 10 cities, 18 boroughs, 27 towns and 70 townships.

For the most part manufacturing is centered in the highly industrialized area around Wilmington, Delaware which contains textile finishing, chemical, vulcanized fibre and leather manufacturing, automobile assembling, shipbuilding and other industries. In the Brandywine Valley area paper manufacture is a leading industry. Agriculture is the main pursuit throughout the rest of the area, although commercial fishing and shellfish production are important sources of income in Delaware Bay. Excellent transportation facilities connect the region to the major Eastern markets.

The principal uses of the Delaware River and Bay in Zone 4 are for navigation, industrial water supply, shellfish culture, commercial fishing and recreation.

Water for domestic and industrial requirements is taken from both surface and underground sources. About 47 million gallons of water per day are supplied to 316,000 people in the basin by 66 public water supply systems. Of this amount about 64 percent is derived from surface water drawn from the Christina River and its Brandywine and White Clay Creek tributaries. The remainder is drawn from 52 underground sources scattered throughout the area. All of the surface water supplies except for one minor facility are filtered and chlorinated at water treatment plants.

A survey of industrial water use conducted by Incodel in 1951 estimated that industries located along the Delaware in Zone 4 used 142 mgd of which 133 mgd are drawn from the stream. In addition millions of gallons from tributaries are used daily by plants throughout the area.

The streams receive the waste waters discharged from 56 municipalities containing 60 separate pollution sources which serve a population of approximately 295,000 or about 59 percent of the estimated population and many industrial establishments in the area. Thirty-six of these municipalities operate 37 sewage treatment works serving a population of 154,250. The raw wastes from 22 of these municipalities serving about 140,650 population are now discharged untreated directly to watercourses in Zone 4. Much of this problem will be alleviated when the Wilmington-New Castle County trunk sewer system and treatment plant now under construction are completed.

Wastes from 61 industrial establishments are discharged directly to watercourses, all but three producing organic wastes. Data available from 38 of these plants indicate the discharge of a pollution load equivalent to that from a population of 1,876,000. Treatment facilities are provided at 34 industrial establishments. Ten industrial sources in Delaware, four of which have waste treatment facilities, will be connected directly to the Wilmington-New Castle County trunk sewer system while numerous other establishments will be served by it through municipal sewer systems.

Much of the damage to the Delaware River in Zone 4 is attributable to pollution originating upstream in Zone 2 and particularly in Zone 3, the Philadelphia-Camden section. The low dissolved oxygen content of the water in the lower Delaware is evidence of its poor quality. Shad migration has been adversely affected by insufficient oxygen.

The shellfish industry has suffered losses because of pollution reaching the Delaware Bay area. Certain former growing areas in the northern reaches of the Bay are closed for the taking of shellfish. The tidal sections of four streams in Delaware and the Cohansey and Maurice Rivers in New Jersey have also been condemned for the taking of marketable oysters because of pollution conditions.

In order to maintain navigation in Wilmington harbor, costly dredging operations must be carried on to clean out the heavy deposits of silt which used to fill the harbor at a rate of about 12 feet in depth each year. Sewage solids combine with this silt in sludge banks which cause odors and discharge gases that discolor paint. The Corps of Engineers also carry on a dredging program in the lower Delaware River to maintain a 40 foot channel depth up to Philadelphia. Devaluation of property adjacent to polluted streams has reached into millions. Oil pollution has destroyed natural habitat for fowl and muskrat in Delaware where hunting is a million dollar sport.

It is expected that pollution abatement measures underway in Zone 3 and aimed at completion by 1956 will vastly improve the quality of the Delaware waters entering Zone 4. Unhealthful and unsightly conditions in the Christina River, Brandywine, White Clay and Red Clay Creeks will be eliminated by the Wilmington - New Castle County trunk sewer system.

Benefits from pollution abatement and soil conservation practices are already in evidence on the Brandywine. Some Brandywine industries, paper in particular, have found that the reusable waste products recovered at their treatment installations have yielded profitable returns.

The 37 municipal sewage treatment plants in the basin serving 154,250 population consist of 16 primary plants serving 69,000 and 21 secondary treatment plants serving about 85,250 more. At present no treatment facilities are provided for almost 50 percent of the sewered population. Represented largely in this latter group is the population of Wilmington and neighboring communities of New Castle County which will soon be served by the Wilmington - New Castle County trunk sewer project. The wastes will be treated at a primary plant now under construction in Wilmington. Nine sewage treatment plants and four industrial waste treatment plants now in operation will be abandoned and connected to the new trunk sewer system.

Of the 61 industrial establishments in Zone 4 discharging wastes directly to streams, 34 produce food products. Included in these are 24 canneries, 6 packers of poultry and meat products and 4 dairies. The paper industry ranks second with 14 plants located in and around the Brandywine Valley. Thirty-four industrial establishments provide treatment facilities for their wastes, while 27 discharge untreated wastes. Improvements are needed at 19 of the plants which now provide treatment.

A list of the municipalities and industries needing improvements as of April 1953 for abatement of pollution in Zone 4 of the Delaware River Basin is set forth in Table J. Basic data as of this same date on the sources of municipal and industrial pollution appear in Tables 1 and 2 in the Appendices.

The minimum requirements of Incodel for treatment of wastes discharged into Zone 4 of the interstate Delaware River are as follows:

ZONE 4: 1. Such effluent shall be free of noticeable floating solids, oil or grease, and substantially free of both suspended solids and sleek.

2. Such effluent shall be sufficiently free of turbidity that it will not cause substantial turbidity in the waters of the Delaware River after dispersion in the water of the river.

3. Such effluent shall show a reduction of at least fifty-five (55) percentum of the total suspended solids and shall be subject to such further treatment as may be needed to prevent a nuisance.

4. Such effluent, if it be discharged within prejudicial influence of a public water works intake, or of recreational areas, or of shellfish grounds, shall at all times be effectively treated with a germicide, except that in the case of recreational area influence, such treatment need not be provided during the period from October fifteenth to May fifteenth of each year.

5. Such effluent shall be sufficiently free of acids, alkalis, and other toxic or deleterious substances that it will not create a menace to the public health through the use of the waters of the Delaware River for public water supplies, or render such waters unfit for commercial fishing, shellfish culture, recreational, industrial, or other purposes.

6. Such effluent shall be practically free of substances capable of producing offensive tastes or odors in public water supplies derived from the Delaware River.

Progress in stream pollution control in the area has been steadily advancing. In 1949 Delaware enacted a comprehensive State water pollution control act with authority vested in the newly created Water Pollution Commission which was given wide powers to administer and enforce all laws relating to water pollution, to set up rules and regulations, and to conduct surveys, investigations and research. To date the Delaware Water Pollution Commission has issued general orders governing the submission of plans and specifications for proposed sewage treatment plants and reports for proposed industrial waste treatment plants. The Board of Health has conducted stream investigations in the Zone 4 area for the Commission. An extensive public information program is carried on in addition to its formal activities.

As the pollution control laws in New Jersey and Pennsylvania were amended and strengthened better results in pollution abatement have been obtained. New Jersey has completed an industrial waste survey of Zone 4 and corrective action is underway. In the Pennsylvania section treatment facilities are provided for all but one municipal source and three industrial sources of pollution. These have facilities under construction or in advanced stages of planning. The progress made by these States has been under the coordinated program prepared cooperatively by them and Incodel for the control of pollution in the Delaware River Basin.

In the Brandywine Creek drainage area which lies in Pennsylvania and Northern Delaware a private citizens group, the Brandywine Valley Association, has been formed to protect and conserve the natural resources of the valley. This unique organization, deriving all of its funds from private contributions and relying solely on education without any legal authority, has achieved notable success in awakening the people of the Brandywine Valley to their water resources problems and in helping solve them.

New construction since World War II has been largely confined to pollution sources in Pennsylvania on the Brandywine and its tributaries. In all, six municipal and eight industrial plants have been constructed or improved. Rapid progress is being made toward completion of the Wilmington-New Castle trunk sewer system and treatment works with completion expected in the fall of 1954 at a cost of $14.5 million. This primary treatment plant will serve 65 percent of Delaware's population and 45 percent of its industry.

A statistical summary of the data set forth in the report is shown in the following tabulation.

DELAWARE RIVER BASIN - ZONE 4

Summary Statistics on Pollution

April 1953

Extracted and Condensed from Tables in the Report

	Sources of Pollution	
	Municipal	Industrial
Number	60	61
Population Served	294,900	-

	Existing Waste Treatment Facilities				
	Municipal			Industrial	
	Primary Treatment	Secondary Treatment	No Treatment	Treatment	No Treatment
Number	16	21	23	34	27
Population Served	69,000	85,250	140,650	-	-

	Waste Treatment Needs					
	Municipal			Industrial		
	No Project Needed	Project Needed	Undetermined	No Project Needed	Project Needed	Undetermined
Number	10	45	5	12	43	6
Population Served	17,200	275,350	2350	-	-	-

	Current Status of Action on Known Treatment Needs					
	Municipal			Industrial		
	Under construction	Planning or Plans Approved	Inactive or Undetermined	Under construction	Planning or Plans Approved	Inactive or Undetermined
Number	22(a)	16	7	11(a)	24	8
Population Served	177,650(a)	75,850	21,850	-	-	-

(a) Includes 18 municipalities (20 sources) with a sewered population of 135,650, and 10 industrial plants which will be served by the Wilmington-New Castle trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

CONCLUSIONS

A review of the data contained in the report indicates the following conclusions:

1. The water quality of the Delaware River from the northern boundary of Zone 4 almost to the Bay is poor. Much of this damage is attributable to pollution occurring upstream in Zones 2 and 3, particularly the Philadelphia-Camden area. The quality of the water in a number of tributaries in Delaware and New Jersey has been impaired to the extent that marketable oysters are no longer permitted to be taken from them. The lower Christina River and its Brandywine, Red Clay and White Clay Creek tributaries have been seriously polluted by municipalities and industries in the Wilmington-New Castle County area of Delaware and in past years by similar sources in the upper reaches in Pennsylvania.

2. The coordinated efforts of the Delaware Water Pollution Commission, New Jersey Department of Health, the Sanitary Water Board of the Pennsylvania Department of Health and Incodel are producing effective results in the abatement of stream pollution in the area. Unhealthful and unsightly conditions in the Christina River and Brandywine, White Clay and Red Clay Creeks will be eliminated by the Wilmington-New Castle County trunk sewer system and treatment plant which are now under construction. All municipalities and all but a few industrial establishments in the Pennsylvania portion of Zone 4 already have treatment facilities. It is also expected that pollution abatement measures underway in Zone 3 will result in vastly improved quality of Delaware River waters entering Zone 4. The program underway is directed toward the elimination by 1955 of all discharges of pollution which do not meet the Incodel requirements.

3. Data concerning municipal sources of pollution are reasonably complete. Additional information is needed concerning the pollution load being discharged to the streams from industrial establishments.

4. Activities for informing the public of the necessity for municipal and industrial waste pollution abatement have been fruitful. The Brandywine Valley Association has achieved notable success in awakening the people of the Brandywine Valley to their water resources problems and in helping solve them.

RECOMMENDATIONS

It is recommended that:

1. The Delaware Water Pollution Commission, the New Jersey Department of Health, the Sanitary Water Board of the Pennsylvania Department of Health and Incodel continue their cooperative program to bring about water pollution control projects in a logical and equitable sequence for restoring and preserving the water resources of the region for their maximum appropriate usefulness.

2. Investigations into the sources of pollution, water use, requirements of water resources for municipal and industrial purposes and stream water quality surveys be continued to enable an appraisal of improvements resulting from pollution control, the effects of future municipal and industrial expansion on stream conditions and to determine adjustments that may be needed to maintain the streams for their appropriate uses.

3. Efforts be continued toward the development of proper land use practices in the area for water and land resources conservation.

4. The State agencies charged with controlling stream pollution continue their public information programs to enlist public support for cleaning up pollution of the streams.

REPORT ON WATER POLLUTION CONTROL
DELAWARE RIVER BASIN - ZONE 4

PHYSICAL DESCRIPTION

The area known as Zone 4 of the Delaware River Basin lies in the northeastern half of Delaware and the southwestern section of New Jersey and also includes a small portion of southeastern Pennsylvania. The drainage area extends from the Pennsylvania - Delaware boundary line on the west bank and Mortonville, New Jersey in southern Gloucester County on the east bank to the Atlantic Ocean and includes Delaware Bay. It includes 2434 square miles excluding the surface area of Delaware Bay, and is divided among: Delaware - 1004 square miles, New Jersey - 1040 square miles, Pennsylvania - 382 square miles, and Maryland - 8 square miles. This area represents about 19 percent of the entire Delaware River Basin of approximately 12,760 square miles.

The basin lies within the two main physiographic divisions of the Atlantic Slope: (1) the Piedmont Plateau in the Brandywine Valley to the "fall line"; and (2) the Coastal Plain, extending eastward from the "fall line" to the Atlantic Ocean. Most of Delaware and New Jersey in Zone 4 are part of the Coastal Plain and consist of low, flat land with few hills as high as 100 feet above sea level. In sharp contrast is the topography in Pennsylvania, where the Brandywine Creek originates in the foothills of the Appalachians and flows southeasterly through hill country until it crosses the Delaware line. There it flows in a deep canyon and drops at Great Falls into an estuary of the Christina River, a tributary of the Delaware.

Soil types vary in the different sections of the area from mostly silt loam in the north to sandy loams predominant in New Jersey and southern Delaware. The soil is well suited to agriculture, particularly truck farming in the sandy loam areas.

The climate in the region is temperate. The mean annual temperature ranges from about 53° in the northern section to 56° near the southern end of Delaware Bay. Average summer temperature is about 75° and the average winter temperature about 36°. Coastal Plain winters tend to mildness and summers are characterized by high humidities coupled with heat which is, however, not often excessive. Precipitation is well distributed throughout the year with a somewhat greater amount falling during the warmer portion of the year. The average annual precipitation varies from about 40 inches near Cape May, New Jersey to about 46 inches in the northern area. While different years show much variation, especially locally, droughts and excessive wet periods are uncommon. The "growing season" or frost-free period in the area is rather long for the latitude, averaging about 190 days.

Unlike the rest of the streams in the area, the Brandywine, flowing down from the hill region of Pennsylvania, is subject to turbulent floods.

In the New Jersey Coastal Plain area the presence of an impervious soil layer just below plow depth greatly reduces infiltration and causes high runoff. The low stream gradients do not permit rapid disposal of the flood runoff.

Stream flows in Zone 4 are usually lowest during August, September and October. There are 24 non-recording and 3 recording precipitation stations and also 12 stream gaging stations in this area. The gaging stations are all located on tributary streams since the Delaware River and Bay are both tidal and therefore flows must be estimated. A gaging station is maintained above the head of tidewater on the Delaware River at Trenton in Zone 2 where the flow of the river is measured. To this figure must be added the flows from tributaries below the gaging station in Zones 2 and 3 and the flow of the Schuylkill River in order to estimate the flow in Zone 4. A summary of the stream flow records at the gaging stations in Zone 4 may be found in Appendix A. Further data concerning stream flows may be found in "Surface Water Supply of the United States - Part 1. North Atlantic Slope Basins", Geological Survey Water-Supply Papers issued by the Department of the Interior, Geological Survey, Washington, D. C.

Ground water is used quite extensively throughout this area for water supply purposes, particularly in the New Jersey section and lower Delaware.

Many small tributary streams enter the Delaware River and Bay in Zone 4. These include Naamans Creek, Christina River, Appoquinimink Creek, Blackbird Creek, Smyrna River, Leipsic River, Dona River, Little River, St. Jones River, Murderkill River, Mispillion River, and the Broadkill River in Delaware; and Salem Creek, Cohansey River and the Maurice River in New Jersey. All of these streams have relatively small drainage areas except for the Maurice River Basin and the Christina River Basin. The latter receives the flow from the Brandywine, Red Clay, and White Clay Creeks.

ECONOMIC DEVELOPMENT

This region contains a population of approximately 497,000 divided among the States about as follows: Delaware, 260,000; New Jersey, 159,000; Pennsylvania, 78,000; and a small number in the eight square miles of the basin that extend into Maryland. Of this population about 210,000 or 42 percent of the total are concentrated in the highly industrialized Wilmington-New Castle County area in Delaware. The only other population centers of more than 10,000 people in Zone 4 are the Cities of Bridgeton and Millville in New Jersey and Coatesville, Pennsylvania. West Chester, Pennsylvania which has sewage treatment plants in Zones 3 and 4, is considered partially in both areas. During the period 1940-1950, the basin population increased about 19.5 percent.

In the State of Delaware, Zone 4 comprises the major portions of New Castle (69%) and Kent Counties (89%) and part of Sussex County (22%). There are 5 cities and 27 towns reported in the 1950 census in all or part of 27 Representative Districts. Population outside of these 32 municipalities is considered rural. The New Jersey section of Zone 4 includes all of Salem County, almost all of Cumberland County (97%) about 1/3 of Cape May County (39%) and small portions of Gloucester (25%) and Atlantic (2%) Counties. There are 4 cities, 9 boroughs and all or part of 32 townships in the New Jersey area. The Zone 4 section of Pennsylvania includes about half of Chester County (49%) and small segments of Delaware (4%) and Lancaster (0.5%) Counties in which are located 1 city, 9 boroughs and 38 townships. The small portion of Zone 4 in Cecil County (2%) Maryland is in Election District 4, Fair Hill.

Population data for Zone 4 of the Delaware River Basin are shown in Appendix B.

For the most part industry in Zone 4 is centered in the highly diversified industrial area of Wilmington-New Castle County in Delaware. This area draws upon the rest of the state and neighboring counties of Pennsylvania, New Jersey, and Maryland for food, raw material and labor supply. The Wilmington-New Castle County Area in 1947 contained over 52% of the industrial establishments in Delaware, employed 70% of the industrial wage earners, and contributed about 67% of the value added by manufacture. Notable in the Wilmington-New Castle County Area are the textile finishing, chemical, vulcanized fibre and leather manufacturing, automobile assembling and shipbuilding industries. The U. S. Department of Commerce in the Census of Manufactures reports that in 1947 there were 482 industrial establishments in the State of Delaware employing 34,465 workers and adding a value of $183,088,000 by manufacture.

In the Brandywine Valley of Pennsylvania, paper manufacture is an important industry. Chester County, about half of which is in Zone 4, had 206 manufacturing establishments, employed 18,449 workers and added a value to products of $93,100,000 by manufacture in 1947.

In New Jersey there has been a recent influx of needle and sewing trades into Cumberland County especially in the municipal centers. Large deposits of silica sand in Salem County have made this region a center of glass manufacturing. In the four counties of New Jersey which have more than 20% of their area within the Zone 4 drainage, there were 418 manufacturing establishments reported in 1947 employing 37,635 workers and adding $211,165,000 by manufacture.

Other important industries in Zone 4 are commercial fishing and shellfish production especially in the Delaware Bay vicinity. It has been estimated that the 1947 oyster catch in the State of Delaware alone amounted to over 500,000 bushels.

Except for the highly industrialized Wilmington area previously mentioned, the main pursuits throughout the rest of Zone 4 of the Delaware River Basin are agriculture and poultry raising. The favorable location of this area near all of the large markets of the East, its climate and soil conditions, and its excellent transportation facilities by rail, truck, water and air, make this section particularly well adapted for truck farming.

In the Brandywine Valley of Pennsylvania and the rural section of northern Delaware, dairy production confined largely to the sale of milk is the leading source of farm income, although crop raising is important. Chester County, Pennsylvania, leads the country in the production of mushrooms. The 1945 Census of Agriculture reports that 78.8% of Chester County is farm land containing 4172 farms which sold $22,611,202 worth of farm products in 1945.

In Kent and Sussex Counties are located the large poultry, fruit and truck farms of Delaware. Poultry raising has developed into a leading industry in the State with a peak production of 73 million broilers in 1945. The truck farms produce diversified crops of asparagus, lima beans, tomatoes, sweet corn, cucumbers, snap beans, squash, pumpkins, spinach, peppers and melons, some of which are moved by truck to the city markets. A large proportion of the truck crop is canned which keeps the numerous commercial canneries of the state busy from mid-summer until frost. In 1945 there were 9296 farms in Delaware occupying 73.5% of the land area and producing $62,253,000 income from farm products sold.

Salem, Cumberland, southern Gloucester and the western half of Cape May Counties in New Jersey are all mainly agricultural in nature with the large part of the farm income from crop and poultry production. Several food processors have established canneries for vegetables, especially tomatoes, in the area. In 1945, the four counties contained 7310 farms occupying over 395,500 acres and producing over 45 million dollars income from products sold.

The only timber growth of significance in the area is found almost entirely on farms and undeveloped lands.

In 1949, the effective buying income in the Delaware River Basin - Zone 4 was estimated to range from $751 per capita in Gloucester County, New Jersey to $1637 per capita in New Castle County, Delaware. In the City of Wilmington the effective buying income was $1951 per capita. The average for the entire United States was $1286 per capita.(1)

Although much of the industrial and agricultural production of Delaware is moved by rail and truck, large quantities are still waterborne, the port of Wilmington being a main link along with Philadelphia and other Delaware ports in the water transportation system.

(1) - Sales Management Magazine, "Survey of Buying Power", 1950

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The Wilmington area is served by the main lines of both the Pennsylvania and Baltimore & Ohio Railroads as well as the Wilmington and Northern Division of the Reading Railroad. The Del-Mar-Va Division of the Pennsylvania Railroad links southern Delaware and the rest of the peninsula to Wilmington. The Central Railroad of New Jersey is the main rail line in the Jersey section of the basin.

Highway facilities in the area are excellent. The Dupont Highway through Delaware, the Delaware Memorial Bridge spanning the river near Wilmington and the New Jersey Turnpike all connect to form a fast dual-lane road northward to Philadelphia and New York City.

PRESENT AND FUTURE USES OF WATER RESOURCES

The principal uses of the Delaware River and Bay in Zone 4 are expected to be for navigation, industrial water supply, shellfish culture, commercial fishing, recreation and other purposes. Except for the Christina River and its tributaries, there are virtually no surface sources used for public water supply in Zone 4. Wilmington draws over 14 mgd, and towns in Pennsylvania draw about 3.5 mgd from the Brandywine and its tributaries. A private water company serving part of the suburban area adjacent to Wilmington draws about 10 mgd from the Christina River and White Clay Creek. In New Jersey the three largest communities, Bridgeton, Millville, and Salem draw part of their supplies from lakes and part from underground sources. Of the 66 sources of public water supply in the basin, 14 are drawn from surface streams, 49 from wells and 3 from springs. Approximately 47 million gallons are supplied daily to 316,000 people in the basin, about 64 percent of which originates from surface waters.

Thirteen surface supplies are both filtered and chlorinated along with six of the well supplies, while 12 underground supplies and one minor surface source are chlorinated. No treatment is given to 31 underground sources supplying 12.7 mgd to 68,000 population.

A survey of industrial water use conducted by Incodel in 1951 estimated that industries located along the Delaware River in Zone 4 used 142 mgd of which 133 mgd are drawn from the stream.

In addition to this amount, millions of gallons daily of process and cooling water from tributaries are used throughout the area by paper plants, steel mills, chemical plants, canneries, textile mills, oyster packing plants, public utilities and others.

All vessels going up or down the Delaware River must pass through Zone 4. In addition to the main ship channel entrance through Delaware Bay, an alternate approach is provided by the Delaware and Chesapeake Canal. It is a government-owned toll free sea level canal, which affords an inland water route between points on the Delaware River and Baltimore and other

Chesapeake Bay ports. The canal is a link in the Atlantic Intercoastal Waterway from Boston to Miami.

The port of Wilmington, although overshadowed by Philadelphia further upstream, is still a port of call for practically all shipping in the Delaware River and Bay and is the home port of the famous Delaware River pilots. During the year 1948, the port of Wilmington handled 1,585,408 tons of traffic, about 65% of which originated at or was shipped to points on the Delaware River and its tributaries or moved locally within the port area. An additional 13% consisted of internal receipts and shipments which entered or left the Delaware River by way of the Chesapeake and Delaware Canal. The tonnage consists mainly of bulk shipments of petroleum products, gravel and sand, and sulfuric acid. Pulp and paper products are also important cargoes. In 1948, Wilmington handled 182,977 tons in foreign trade, over 99% of which was imported to this country.

Commercial fishing in the Delaware River and Bay includes both fin fish such as shad, striped bass and sea trout, and shellfish as clams, oysters, lobsters and crabs. The greatest portion of the income derived by the commercial fisheries is presently contributed by shellfish. The value of the catch from the Bay area in 1949 was: oysters, $3,648,000; clams, $794,000; and crabs, $415,000. The shad run on the Delaware which once totaled 16,000,000 pounds amounted to only 38,000 pounds in 1949. Large schools of menhaden, a fish utilized for fertilizer and oil, are found in the Delaware Bay. The catch of these each year amounts to many thousands of pounds and the processing of them in plants at Lewes, Delaware is extensive.

It is expected that in the future streams such as the Mispillion River, St. Jones River, Murderkill River and Broadkill River in Delaware will again become approved as shellfish growing areas. Pollution conditions have caused these areas to be condemned for the taking of marketable shellfish at present.

The waters of Delaware Bay are widely used for recreation. Boating is popular throughout the area of Zone 4 and the recently built canal across the tip of the Cape May peninsula connects the area to the Atlantic Coastal waterways of New Jersey. There are also extensive beach and bathing areas along the New Jersey shore of the Bay in Cape May County and along the Delaware shore. These are largely undeveloped at present but offer vast opportunities for future development by the States. Duck shooting and hunting are popular sports in the marsh areas of New Jersey and the southern portion of Delaware which serve as stopping off points and wintering areas for many species of migratory fowl. Along the Delaware River at Bombay Hook, a National Wildlife Refuge has been established.

The existing primary water uses and stream status are shown on Map No. 1.

POLLUTION CONTRIBUTED TO WATER RESOURCES

A summary of available data indicates there are 60 pollution sources located in 56 municipalities in Zone 4 discharging waste directly to streams or to the Bay through municipal sewer systems. These systems serve a population of approximately 295,000 or about 59 percent of the estimated population of the area and also receive the wastes of many industries. Of these systems, 15 serve a population of 81,800 and discharge to the watercourses a pollution load estimated to be equivalent to that from a population of 33,150. Data concerning the pollution load discharged from the remaining 45 sources which serve 213,100 people are incomplete. (See Table A.)

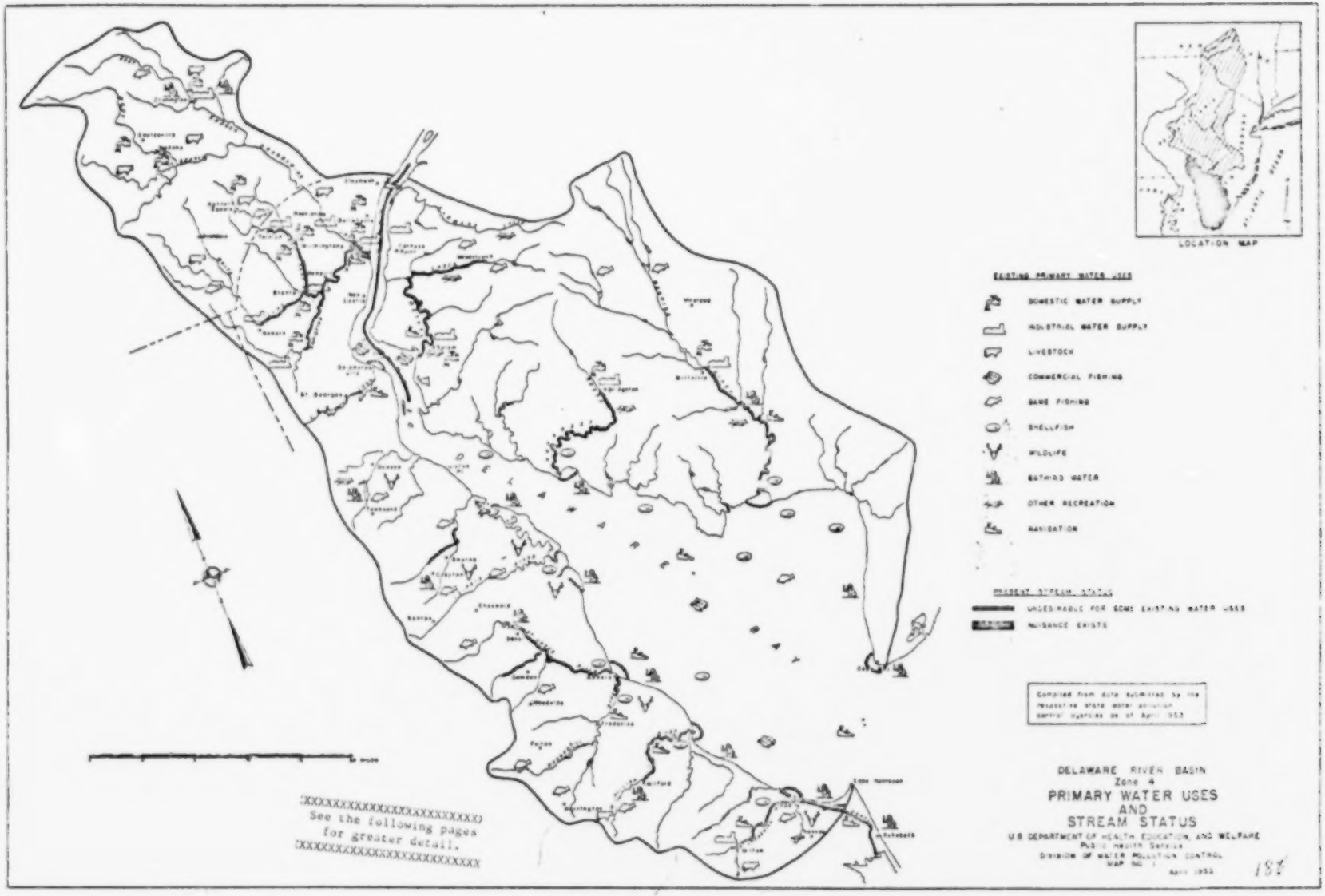
The major part of the pollution load is discharged from Wilmington and from adjacent communities in New Castle County into the Christina and Brandywine. When the Wilmington-New Castle County trunk sewer system is completed, all of this raw sewage and considerable industrial waste plus the wastes now being treated in many small treatment plants in this area will be carried in the trunk sewer to the new Wilmington plant now under construction. The treated primary effluent from this one central plant will be discharged to the Delaware River.

The Delaware State Board of Health has completed surveys for the Water Pollution Commission of the Broadkill River, Mispillion River and Red Clay Creek drainage basins in Zone 4. The investigation of the Christina River with its tributaries, such as the Lower Brandywine and White Clay Creeks, is underway. Stream conditions existing prior to the present Wilmington-New Castle trunk sewer construction have been ascertained and will be compared to the post-construction period.

There are 61 industries in Zone 4 having separate outlets discharging wastes directly to watercourses, all but three producing organic wastes. The wastes from 38 of these plants are equivalent to the sewage from a population of over 1,876,000. The strength of organic wastes discharged from 20 plants has not been determined. (See Table B.)

The greatest source of organic industrial pollution in Zone 4 is the E. I. duPont de Nemours & Co. plant at Deepwater, New Jersey which alone contributes wastes equivalent to that from a population of 1,600,000. This plant has a compositing basin for neutralizing its wastes and is now planning for further treatment. In Delaware there are 10 industrial plants which will shortly connect to the Wilmington-New Castle County Trunk sewer system after which they will no longer be considered as separate sources of pollution.

Map No. 2 shows the sources of pollution and existing treatment facilities in Zone 4.


LOCATION MAP
EXISTING PRIMARY WATER USES
DOMESTIC WATER SUPPLY
INDUSTRIAL WATER SUPPLY
LIVESTOCK
COMMERCIAL FISHING
GAME FISHING
SHELLFISH
WILDLIFE
BATHING WATER
OTHER RECREATION
NAVIGATION
PRESENT STREAM STATUS
UNSATISFACTORY FOR SOME EXISTING WATER USES
NUISANCE EXISTS
Compiled from data submitted by the respective state water pollution control agencies as of April 1953
DELAWARE RIVER BASIN
Zone 4
PRIMARY WATER USES
AND
STREAM STATUS
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 1
April 1953
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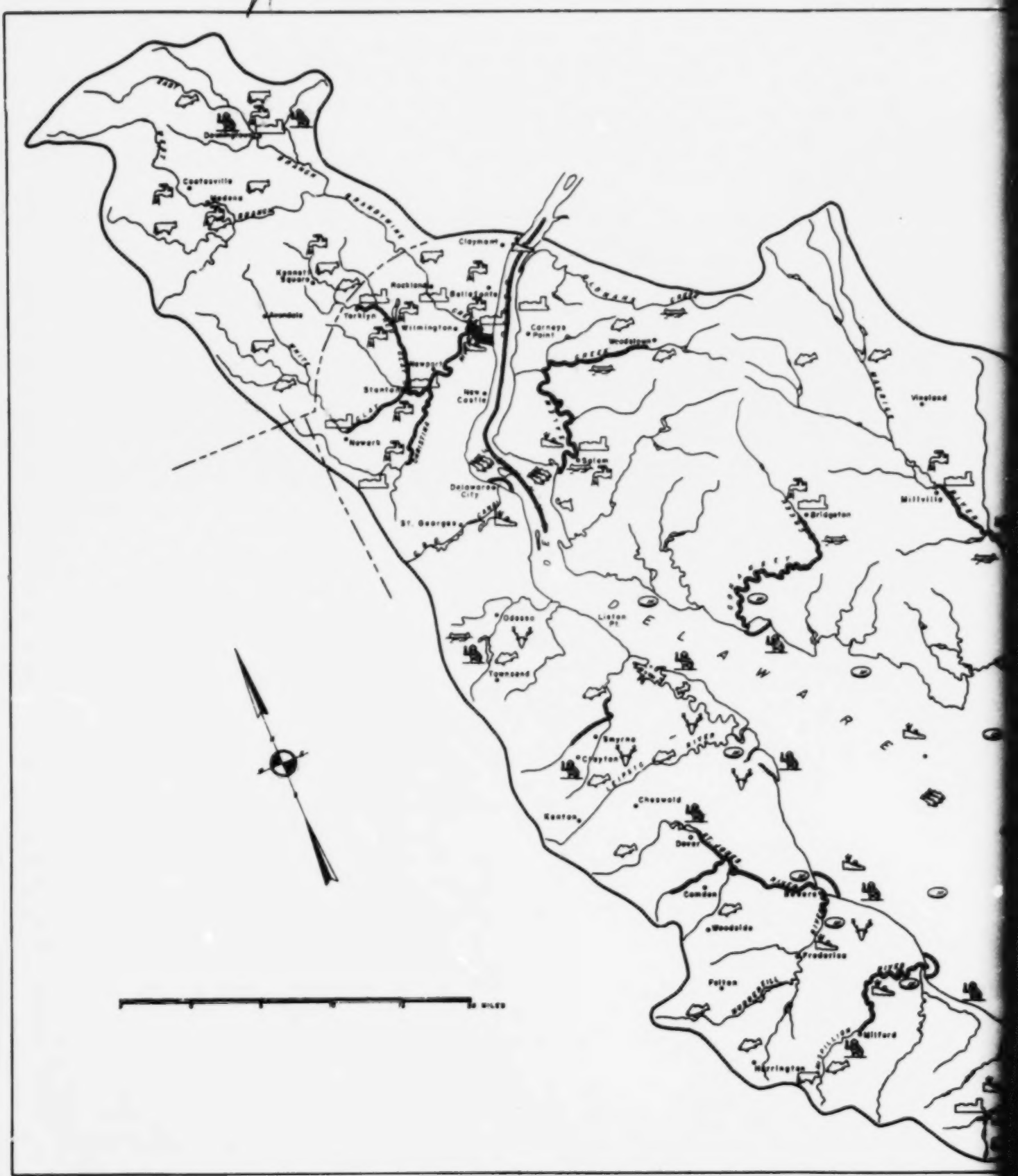
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXXX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New Castle
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St. Georges
Odessa
Townsend
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Camden
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Frederica
Felton
Milford
Harrington
Viola
Milltville
Bridgeton
Lisbon Pt.
DELAWARE
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Delaware
Wilmington
Newark
Yorklyn
Rockland
Greenville
Centreville
Corners Point
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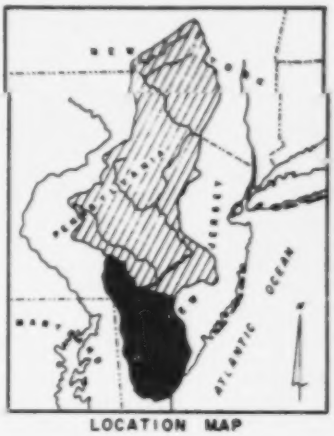
Salem
Vineland



LOCATION MAP

EXISTING PRIMARY WATER USES

- DOMESTIC WATER SUPPLY
- INDUSTRIAL WATER SUPPLY
- LIVESTOCK
- COMMERCIAL FISHING
- GAME FISHING
- SHELLFISH
- WILDLIFE
- BATHING WATER
- OTHER RECREATION
- NAVIGATION

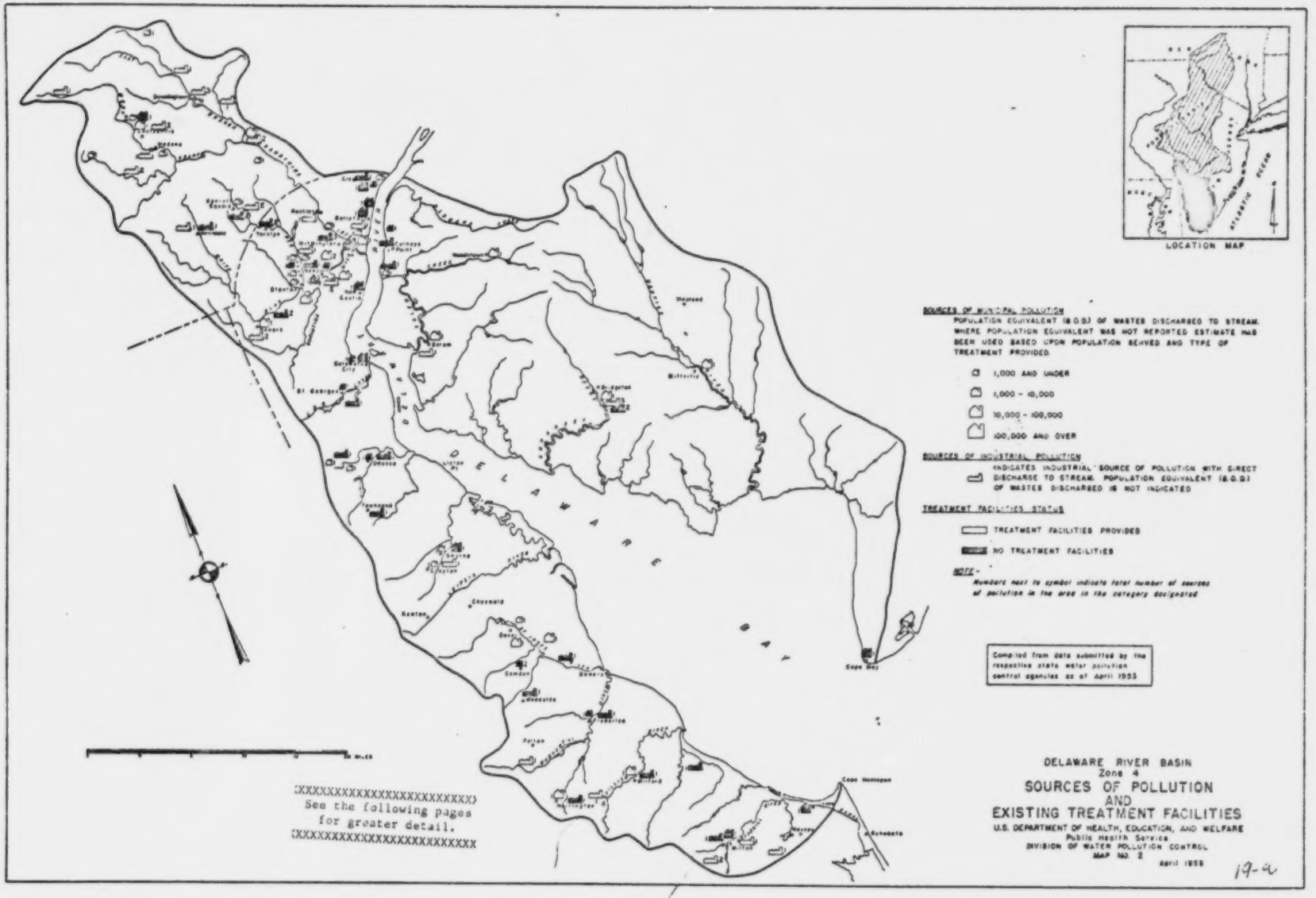
PRESENT STREAM STATUS

- UNDESIRABLE FOR SOME EXISTING WATER USES
- NUISANCE EXISTS

Compiled from data submitted by the respective state water pollution control agencies as of April 1953

DELAWARE RIVER BASIN
Zone 4
PRIMARY WATER USES AND STREAM STATUS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 1
April 1953


LOCATION MAP
SOURCES OF MUNICIPAL POLLUTION
POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED TO STREAM. WHERE POPULATION EQUIVALENT WAS NOT REPORTED ESTIMATE HAS BEEN USED BASED UPON POPULATION SERVED AND TYPE OF TREATMENT PROVIDED
1,000 AND UNDER
1,000 - 10,000
10,000 - 100,000
100,000 AND OVER
SOURCES OF INDUSTRIAL POLLUTION
INDICATES INDUSTRIAL SOURCE OF POLLUTION WITH DIRECT DISCHARGE TO STREAM. POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED IS NOT INDICATED
TREATMENT FACILITIES STATUS
TREATMENT FACILITIES PROVIDED
NO TREATMENT FACILITIES
NOTE -
Numbers next to symbol indicate total number of sources of pollution in the area in the category designated
Compiled from data submitted by the respective state water pollution control agencies as of April 1955
DELAWARE RIVER BASIN
Zone 4
SOURCES OF POLLUTION
AND
EXISTING TREATMENT FACILITIES
U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 2
April 1955
19-a

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See the following pages
for greater detail.
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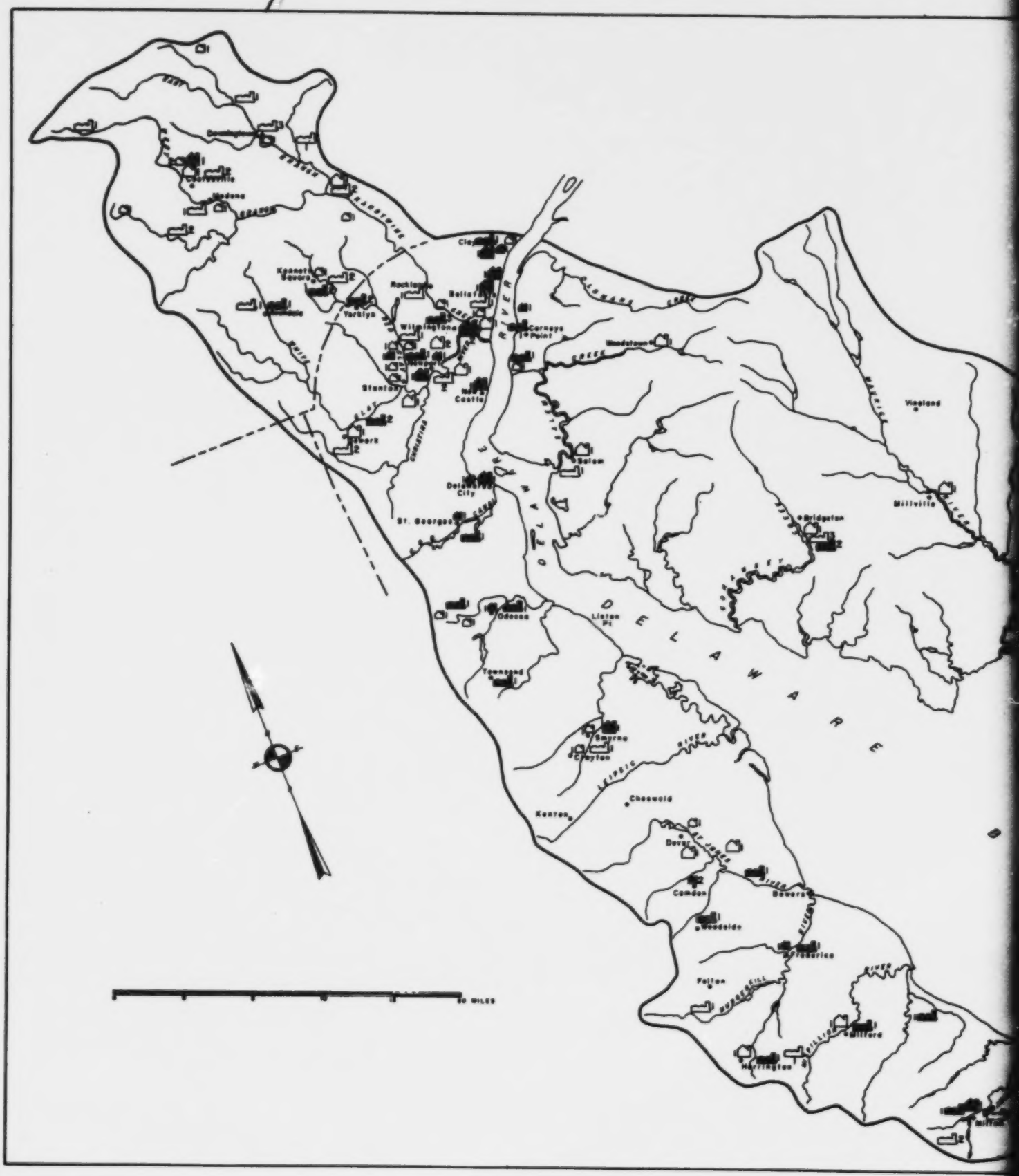
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Viola
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Bridgeton
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Odessa
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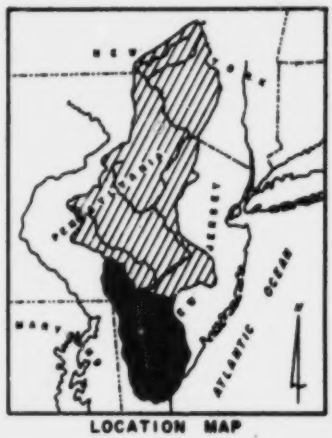
Woodstown
Yorklyn
Stanton
Newport
Wilmington
Delaware City
St. Georges
Liston Pt
Delaware River
Delaware Bay
50 MILES



LOCATION MAP

SOURCES OF MUNICIPAL POLLUTION

POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED TO STREAM. WHERE POPULATION EQUIVALENT WAS NOT REPORTED ESTIMATE HAS BEEN USED BASED UPON POPULATION SERVED AND TYPE OF TREATMENT PROVIDED.

- 1,000 AND UNDER
- 1,000 – 10,000
- 10,000 – 100,000
- 100,000 AND OVER

SOURCES OF INDUSTRIAL POLLUTION

INDICATES INDUSTRIAL SOURCE OF POLLUTION WITH DIRECT DISCHARGE TO STREAM. POPULATION EQUIVALENT (B.O.D.) OF WASTES DISCHARGED IS NOT INDICATED

TREATMENT FACILITIES STATUS

- TREATMENT FACILITIES PROVIDED
- NO TREATMENT FACILITIES

NOTE -

Numbers next to symbol indicate total number of sources of pollution in the area in the category designated

Compiled from data submitted by the respective state water pollution control agencies as of April 1953

DELAWARE RIVER BASIN
Zone 4
SOURCES OF POLLUTION AND EXISTING TREATMENT FACILITIES

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 2
April 1953

19-a

TABLE A

DELAWARE RIVER BASIN - ZONE 4

Sources of Pollution

April 1953

Municipal*

Municipalities	Sources of Pollution (In Number of Municipalities)	Population Served by Sewerage System	Amount of Pollution Discharged to Water-course (In Terms of ** Equivalent No. of People)
Having data on pollution load discharged to watercourse	15 (15 sources)	81,800	33,150
Having population data available (Data on pollution load to water-course incomplete or not available)	41 (45 sources)	213,100	Undetermined
TOTAL	56 (60 sources)	294,900	------

*Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other population centers.

**Includes industrial wastes discharged into municipal sewerage systems.

TABLE B

DELAWARE RIVER BASIN - ZONE 4

Sources of Pollution

April 1953

Industrial*

Industries	Sources of Pollution (In Number of Plants)	Amount of Pollution Discharged to Watercourse (In terms of Equivalent Number of People)**
Producing Organic Wastes	38 (a)	1,876,350
Producing Organic Wastes	20	Undetermined
Producing Inorganic Wastes	3	Not applicable
TOTAL	61	-----

* Industries having separate outlets discharging wastes directly to watercourse. The waste from industries which discharge into a municipal sever system are included in the municipal discharge in Table A.

** Population Equivalent - The calculated population which would normally contribute the same amount of biochemical oxygen demand (B.O.D.) per day. A common base is 0.167 pounds of 5-day B.O.D. per capita per day.

(a) Includes two sources which discharge both organic and sanitary sewage wastes.

DAMAGES TO WATER RESOURCES FROM POLLUTION

Much of the damage to the water resources of Zone 4 of the Delaware River is attributable to pollution which occurs upstream on the Delaware in Zones 2 and 3 from Trenton to Marcus Hook. The Philadelphia-Camden area in particular has been a major source of pollution which over the years has caused damage to Zone 4. For a detailed account of the water pollution problem in these areas the reader is referred to the previously published reports of the Public Health Service on Zones 2 and 3 of the Delaware River. (2) (3)

A picture of the serious damage to the Delaware River can be seen in the analysis of the water as it enters Zone 4 from the area above. Samples taken by the Delaware State Board of Health in September 1952 above Edgemoor, about four miles below the Zone 4 boundary, show that at dead low tide the dissolved oxygen varied from as low as 10 percent of saturation in the channel near Delaware to 44 percent near the New Jersey shore. The lack of dissolved oxygen could only be attributed to upstream pollution. Proceeding downstream from Edgemoor there was a gradual increase in oxygen content more evident below New Castle. Samples taken in the channel 30 miles below at Woodland Beach in Delaware Bay showed that the dissolved oxygen content had risen to about 75 percent of saturation.

A previous water quality investigation of the Delaware River by Ellis et al., (4) concluded that the detrimental factors affecting shad migration within the Delaware River as measured in 1946 could not be attributed to other characteristics of the water than the low dissolved oxygen. It was found that a barrier to the migration of shad to their spawning grounds existed from Pennsville, New Jersey in Zone 4 to north of Philadelphia where the stream was found to contain less than 5 ppm dissolved oxygen and for some stretches less than 2 ppm. A dissolved oxygen content of 5 ppm is considered by the authors as the minimum that shad can tolerate at the time of their upstream and downstream migrations.

The shellfish industry has suffered losses because of pollution reaching the Delaware Bay area. In former years oysters were grown throughout the Bay including the northern reaches and in the mouth of the Delaware River above Liston Point. Now much of this northern area has been condemned for the taking of shellfish because of poor water quality and excessive coliform concentrations.

(2) Delaware River Basin - Zone 3, Water Pollution Series No. 41, Federal Security Agency, Public Health Service, May 1952.

(3) Delaware River Basin - Zone 2, Water Pollution Series No. 48, U. S. Department of Health, Education, and Welfare, Public Health Service, September 1952.

(4) Ellis, M. M., Westfall, B. A., Meyer, D. K., and Platner, W. S., "Water Quality Studies of the Delaware River with Reference to Shad Migration", 1947.

In Delaware the tidal areas of the St. Jones, Mispillion, Murderkill, and Broadkill Rivers have also been condemned for the taking of marketable oysters because of local sources of pollution. At present these areas are used only as a source of seedling oysters which must be replanted in unpolluted waters. A similar situation exists on the Cohansey and Maurice Rivers in New Jersey. Until condemned because of pollution, the lower reach of the Mispillion alone had been a source of about 20,000 bushels of marketable oysters valued at $40,000 annually. Under average conditions the annual take on the Broadkill was 75,000 bushels worth $150,000. It has been estimated that the million dollar shellfish industry could be increased many fold after abatement of pollution permits reopening of the condemned areas along with the improvement of existing shellfish area.

Corrosive wastes attack shipping and excessive solids gather in sludge banks which cause odors and discharge gases that discolor paint - all of which are detrimental to navigation. The expense caused by silt accumulations is evident in Wilmington harbor. In order to keep the harbor deep enough for the ocean-going freighters, the U. S. Army Corps of Engineers are required to remove over 1,500,000 cubic yards of silt by dredging operations each year. The cost of this work has been about $300,000 annually. A greater damage has been the loss of valuable topsoil from farmland which fills up the harbor at the rate of 12 feet each year from the Brandywine, White Clay and Red Clay Creeks, and the Delaware and Christina. Devaluation of once valuable property adjacent to these streams and in Wilmington harbor has reached into millions of dollars.

A similar situation on a much smaller scale has occurred on the Mispillion River which is navigable to Milford and is used today by the many small boats in the area. The formation of sludge banks in the river has necessitated costly dredging operations in order to maintain a navigable depth.

In addition to these operations on tributary streams for the past 50 years the Corps of Engineers have had a dredging program on the lower Delaware River to keep the channel areas open to navigation. In order to maintain the 40 foot depth of channel to Philadelphia about 15,000,000 cubic yards of silt are removed annually.

Oil pollution has destroyed natural habitat for fowl and muskrat in Delaware where hunting is a million dollar sport. In addition the Fish and Wildlife Service reports that turbidity in upper Delaware Bay, resulting from pollution, has been so great that valuable submerged plants can not survive in the area. Insufficient light penetration has eliminated important waterfowl foods such as wild celery, sago, pondweed, naiads and widgeon grass. The injury to valuable aquatic life that depend importantly on this vegetation has been tremendous.

The income formerly derived from the annual shad runs has declined considerably along with the decrease in shad entering the Delaware. This

decrease has been attributed to the low concentration of dissolved oxygen caused by pollution.

In the Brandywine area the Brandywine Valley Association has been very active in helping to preserve the natural resources in the area but damages are still evident. Records of U. S. Geological Survey gaging stations show that in the two year period 1947-48 about 90,000 tons of silt were swept down the Brandywine. Fishing in the Brandywine had declined considerably before the start of the correction program, the lower portion of the stream being so polluted that fish could not survive at all.

BENEFITS RESULTING FROM POLLUTION PREVENTION AND ABATEMENT

The coordinated program of the Interstate Commission on the Delaware River Basin being carried out by the Delaware Water Pollution Commission, and State Board of Health, the New Jersey State Department of Health and the Sanitary Water Board in the Pennsylvania Department of Health in conformity with the reciprocal agreement for the control of pollution in the waters of the interstate Delaware River, and supported by other interested agencies, is eliminating the sources of pollution. It is hoped that by 1956 the waters in Zone 3, the zone of heaviest pollution immediately above Zone 4, will have reached a degree of recovery which will restore the dissolved oxygen content to at least 50% saturation at all times. This in turn insures that water vastly improved in quality will enter into Zone 4.

A sanitary survey of the Delaware River in the Zone 3 area underway since August 1949 by the City of Philadelphia, the U. S. Geological Survey, and Incodel indicates improvement in the stream during the period of the survey. There has been a decrease in odors, an increase in the dissolved oxygen in many portions of the stream and a general improvement. Surveys by the Fish and Wildlife Service indicate that shad runs on the Delaware could be restored to their former abundance bringing a yearly income of three to four million dollars when pollution is eliminated, provided that anticipated high dams do not block the upstream migration.

In the State of Delaware the cleanup of pollution on the Mispillion, Murderkill, Broadkill and St. Jones Rivers would reopen those streams for the growing of marketable shellfish. Progress is well underway on the St. Jones River where Dover is now constructing additions to its treatment works and the Dover Air Force Base is planning for additions to its facilities.

The expected completion of the Wilmington-New Castle County trunk sewer system in the fall of 1954 will bring about a vast improvement in the quality of waters in the Christina River, Brandywine, Red Clay and White Clay Creeks. Unhealthful and unsightly conditions will be eliminated. Coupled with this project in Delaware are the achievements in the upper tributaries of the Brandywine, Red Clay and White Clay Creeks in Pennsylvania. In this

Zone 4 area of Pennsylvania all nine sewered municipalities and institutions already have facilities for treating their sewage and 16 industries have waste treatment facilities, one is constructing new facilities and the two remaining plants are planning to construct them in the near future.

The benefits of these pollution abatement projects along with those derived from the extensive soil conservation practices being instituted throughout the Brandywine Valley are already becoming evident. Added protection is afforded to the municipal water supplies drawn from these streams. The supplies of Wilmington and the other communities drawing water from the Brandywine together serve about 150,000 people with 18.0 mgd. These municipalities and the industrial users receive a purer, less silt-laden water which results in decreased treatment costs. The problems of the City of Wilmington in removing tastes and odors from its water supply will be greatly eased.

The paper industry in particular has derived double benefits from the pollution abatement program. Not only does it receive a purer water essential to the making of quality paper, but in many plants treatment installations recover enough wasted process materials to pay the cost of treatment and in some cases to make their operation profitable. The recovery unit at the Downingtown Paper Company recovers large quantities of usable material, fibre, and filler and is reported to be a profitable operation. The Lukens Steel Company in Coatesville recovers iron oxide from the waste waters and returns it for reprocessing.

Another benefit to be derived from the programs in the Brandywine Valley and the other Christina River tributaries will be in improvements to Wilmington harbor. Dredging costs, formerly in the neighborhood of $300,000 annually, will be greatly reduced. Also the top soil which comprised the bulk of the silt load will remain on the farm lands where it is put to profitable use rather than being wasted down the river and hampering navigation.

Fishing is also improving on the Brandywine with the removal of the heavy silt load and the industrial pollutants which had been destroying fish life. With the completion of the Wilmington system and the removal of raw sewage outfalls from the lower Brandywine, recreational facilities will be developed further in Brandywine Park. Fishing and bathing for children will be possible without the present dangers to health from untreated sewage, and the aesthetic beauty of the stream will be returned.

POLLUTION PREVENTION MEASURES IN EFFECT

Treatment Facilities

In Zone 4 of the Delaware River Basin, there are 37 municipal sewage treatment plants in operation serving a population of 154,250. Of this number 16 plants provide primary treatment serving 69,000 people and 21 provide secondary treatment for 85,250 more. (See Table C.)

No treatment facilities are provided for 23 municipal systems which

TABLE C

DELAWARE RIVER BASIN - ZONE 4

April 1953

Existing Treatment Facilities

Municipal*

Degree of Treatment Provided	Number of Municipalities Served	Number of Treatment Plants	Population Served
Primary	16	16(a)	69,000
Secondary	20(b)	21	85,250
No Treatment	22(b)	23	140,650
TOTAL	56(c)	60	294,900

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers, or other population centers.

(a) Includes two plants with minor treatment facilities.

(b) Wilmington, Delaware is served by one secondary treatment plant and two raw waste discharges, South Coatesville, Pennsylvania is served by two secondary treatment plants and one raw waste discharge.

(c) Total corrected for double entry of Wilmington and South Coatesville in both the secondary and no treatment columns.

TABLE C

DELAWARE RIVER BASIN - ZONE 4

April 1953

Existing Treatment Facilities

Municipal*

Degree of Treatment Provided	Number of Municipalities Served	Number of Treatment Plants	Population Served
Primary	16	16(a)	69,000
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No Treatment	22(b)	23	140,650
TOTAL	56(c)	60	294,900

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(a) Includes two plants with minor treatment facilities.

(b) Wilmington, Delaware is served by one secondary treatment plant and two raw waste discharges, South Coatesville, Pennsylvania is served by two secondary treatment plants and one raw waste discharge.

(c) Total corrected for double entry of Wilmington and South Coatesville in both the secondary and no treatment columns.

carry the waste from about 140,650 population, or almost 50% of the total population in Zone 4 served by municipal sewer systems. Represented largely in this number are the population of Wilmington and neighboring communities in New Castle County. These will soon be served by the Wilmington-New Castle County trunk sewer project and treated at a primary plant to be located in Wilmington.

Thirty-four of the industrial establishments in Zone 4 are served by waste treatment facilities, while the wastes of the remaining 27 industries are discharged untreated directly into watercourses. (See Table D.) It is to be noted that 34 of the 61 industries which are sources of pollution produce food and kindred products. Of this number 24 are canneries, 6 produce poultry or meat products and 4 produce dairy products. The paper industry ranks next with 14 plants in the Brandywine, Red Clay and White Clay Creek basins. The chemical and metal industries follow in order in number of sources of pollution.

New construction completed since World War II, 1946-1952, for abatement of stream pollution in Zone 4 of the Delaware River Basin has been largely confined to sources on the Brandywine Creek and tributaries in Pennsylvania. Six municipal and eight industrial treatment works have been constructed or improved. (See Table E.) Westchester and Downington have enlarged and improved their old plants and two institutions have built new facilities. Industries in Pennsylvania which have completed new treatment works are National Vulcanized Fibre Company and A. D. Pierce Company on Red Clay Creek; Seabrook Farms on White Clay Creek; Eagle Paper Mills, the Davey Company and the Lukens Steel Company on tributaries of the Brandywine. In Delaware, the Paramount Poultry Company has instituted extensive changes in equipment design which will eliminate 95% of its waste load. Seabrook Farms in New Jersey, the nation's largest truck farm and frozen food factory, has successfully instituted woodland irrigation practices to dispose of its waste process water in the soil.

Incodel Requirements

The control of wastes discharged into the waters of Zone 4 of the Delaware River Basin is under the jurisdiction of the Water Pollution Commission of the State of Delaware, the New Jersey State Department of Health, and the Sanitary Water Board of the Pennsylvania Department of Health. Each State has laws controlling the discharge of wastes into the waters of the respective States. In addition thereto the States have enacted reciprocal legislation known as the Incodel Act, which provides minimum treatment requirements for all wastes discharged into the Delaware River and the maintenance of the waters of any intrastate tributary of the Delaware immediately above its confluence with the Delaware River in condition at least equal to that in the Delaware River immediately above the confluence of such tributary. The Incodel laws enacted in these three States are Delaware - Chapter 93, May 8, 1941; New Jersey - Chapter 146, July 1, 1939; and Pennsylvania - Chapter 123, April 19, 1945. There is close cooperation between the State water pollution control agencies and Incodel, with Incodel acting as the coordinating agency.

TABLE D

DELAWARE RIVER BASIN - ZONE 4

Existing Treatment Facilities

April 1953

Industrial*

Type of Industry	Number of Plants	Number of Industrial Plants Having: Treatment Facilities	No Treatment Facilities
Food and Kindred	34(a)	19	15
Textile	2	0	2
Lumber	1	1	0
Paper and Allied	14	8	6
Chemical	6	3	3
Primary Metals	1	1	0
Fabricated Metals	1	0	1
Petroleum and Coal Products	1	1	0
Miscellaneous	1	1	0
TOTAL	61	34	27

* Industries having separate outlets discharging wastes directly to watercourse.

(a) Includes the following breakdown:

Type of Food and Kindred Industry	Number of Plants	Number of Food & Kindred Plants Having: Treatment Facilities	No Treatment Facilities
Cannery	24	10	14
Dairy	4	3	1
Abattoir (meat or poultry)	6	6	0
Food & Kindred TOTAL	34	19	15

TABLE E

DELAWARE RIVER BASIN - ZONE 4

Progress in Construction of Pollution Abatement Facilities

	Municipal		Industrial	
Year	Sewage Treatment Plants Completed	Design Population	Waste Treatment Plants Completed	Amount of Waste Treated (In terms of Equivalent No. of People
1946	-	-	-	
1947	1	1200	1	Data
1948	1 (a)	6700	-	not
1949	-	-	1	avail-
1950	1	200	5	able
1951	-	-		
1952	3 (c)	16,200	1 (b)	

(a) Enlargement
(b) Process changes
(c) 1 new plant, 1 replacement, 1 addition

The minimum requirements of Incodel for treatment of wastes discharged into Zone 4 of the interstate Delaware River are as follows:

ZONE 4: 1. Such effluent shall be free of noticeable floating solids, oil, or grease, and substantially free of both suspended solids and sleek.

2. Such effluent shall be sufficiently free of turbidity that it will not cause substantial turbidity in the waters of the Delaware River after dispersion in the water of the river.

3. Such effluent shall show a reduction of at least fifty-five (55) per centum of the total suspended solids and shall be subject to such further treatment as may be needed to prevent a nuisance.

4. Such effluent, if it be discharged within prejudicial influence of a public water works intake, or of recreational areas, or of shellfish grounds, shall at all times be effectively treated with a germicide, except that in the case of recreational area influence, such treatment need not be provided during the period from October fifteenth to May fifteenth of each year.

5. Such effluent shall be sufficently free of acids, alkalis, and other toxic or deleterious substances that it will not create a menace to the public health through the use of the waters of the Delaware River for public water supplies, or render such waters unfit for commercial fishing, shellfish culture, recreational, industrial, or other purposes.

6. Such effluent shall be practically free of substances capable of producing offensive tastes or odors in public water supplies derived from the Delaware River.

State Laws and Regulations

On June 29, 1949, Delaware enacted a comprehensive State water pollution control act with authority vested in a newly created Water Pollution Commission. "Pollution" is broadly defined and refers to substances rendering waters of the State unclean to the extent of being harmful or inimical to the public health, or to animal or aquatic life, or to the use of such waters for domestic water supply, industrial purposes, recreation, or other legitimate and necessary uses. It is the declared purpose of the comprehensive law to safeguard the quality of State waters against pollution by preventing new pollution and by abating pollution existing on the date when the law was adopted. Under the statutes in effect prior to the enactment of the comprehensive law, the safeguarding of the public health and the protection of fish were considered the sole objective and the effect of pollution on other water uses was not covered.

The Delaware Water Pollution Commission, an independent body with the State Board of Health as its administrative agent, has general supervision over the administration and enforcement of all laws relating to the pollution of waters and is directed to study and investigate all pollution problems and to make reports and recommendations thereon. The Commission is also directed to conduct scientific experiments, investigations and research; to cooperate with any public or private agency for this purpose and to accept funds on behalf of the State. Authority is also granted to the Commission to enter into agreements with other States and the Federal Government.

The enforcement provisions of the Delaware Act delegate to the Commission the authority to issue general orders, adopt rules and regulations applicable throughcut the State for the installation, use and operation of sewerage systems, treatment of refuse and the disposal of industrial or other wastes. Before these may be issued opportunity to be heard must be granted to all interested parties. Special orders may be issued only after

hearing and shall direct persons or political entities to comply therewith within a specified time. Inspections and investigations are authorized to insure compliance with Commission issuances, and power to require submission for approval of plans for treatment systems is granted.

To date, the Delaware Water Pollution Commission has issued general orders governing the submission of plans and specifications for proposed sewage treatment works and the submission of reports for proposed industrial waste treatment plants. Stream investigations have been completed by the Board of Health in the Broadkill River, Mispillion River and Red Clay Creek basins of Zone 4. Still underway are investigations of the Christina River, Brandywine, White Clay, and Appoquinimunk Creek areas, and surveys of the remaining basins in Zone 4 in Delaware are planned for the future.

Pollution prevention measures in New Jersey are based upon two laws, both enacted in 1899 and later amended and supplemented. One of these laws, "An Act to secure the purity of public supplies of potable waters", prohibits the discharge of excremental matter, industrial wastes or other polluting matter into water later used for potable purposes; as well as the deposition of such materials upon the banks of such waters. However, "An Act to regulate the discharge of effluents from sewage systems or works into potable waters", (Act of 1921) provides that effluents from sewage and industrial waste treatment plants may be discharged into waters later used for public potable purposes; provided, that, in the opinion of the State Department of Health, such effluents discharged will or may not cause or threaten injury to the users of any of such waters. The second law, the State Sewerage Act, applies to all waters of the State. Under the provisions of this law, the State Department of Health is granted the following authority: (1) to investigate the various methods of sewage or waste disposal in order that it may make proper recommendations in regard thereto; (2) to require that anyone polluting the waters of the State in such manner as to cause or threaten injury to any inhabitants of the State, either in their health, comfort or property, cease such pollution; (3) to require alterations, additions or improvements to sewage or industrial waste treatment works; (4) to establish the conditions under which any sewer, drain or sewerage system shall be built; and (5) to establish the conditions under which any plant for the treatment of sewage or other polluting substance shall be built or operated. The law provides, further, that before the building of any plant for the treatment of sewage or other polluting substances, the plans shall be submitted to the State Department of Health for approval. The New Jersey Department of Health has conducted an industrial waste survey of Zone 4 and corrective action is underway.

The program for abatement of stream pollution in Pennsylvania is conducted by the Sanitary Water Board, an agency within the Department of Health, under the Pennsylvania Anti-Pollution Act of 1937 as amended in 1945. The first phase of the program, which involves the issuance of orders to municipalities and industries which are polluting the waters of the State to abate the discharges of such pollution or submit to the Board plans of corrective measures for approval, is completed in Zone 4 of the Delaware River Basin. The second phase is concerned with the construction and operation of the required

waste treatment facilities. Following approval of the detailed plans the Board issued orders requiring construction and operation of the approved facilities on or before specified dates. This phase of the program in the Pennsylvania section of the basin is also well advanced. All municipalities have sewage treatment works and of the 19 industries which discharge their waste to streams, 16 have facilities in operation, one has new facilities under construction and the two remaining are in advanced planning stages. Two municipal sewage treatment plants are to be replaced by a new plant which will serve the same area and also an additional area not now provided with treatment. New or reopened industrial establishments must provide for adequate waste treatment before beginning operations.

Specific standards have been adopted by the Pennsylvania Sanitary Water Board for certain industrial wastes including milk processing wastes, colliery silt, acid pickling waste waters, wastes arising from the manufacture of pulp, paper, paper board and similar products, oil and natural gas wells, wastes from other wells, phenolic bodies, oil bearing wastes, distillery wastes, tannery waste waters and mine drainage. The discharge of cyanides to the waters of the State is prohibited. In general the standards set forth values representative of standard raw waste characteristics which serve as the basis upon which the required degree of treatment is applied.

Provisions governing financing the construction and operation of municipal sewage treatment plants are contained in the laws of the respective States.

The debt limit in New Jersey is 7% of the average assessed valuation of real property including improvements for municipalities and 4% for counties. A municipality with indebtedness over the limit may incur new debt only within the limitations of the statute, which in brief are the orders of a superior governmental authority such as an order of the State Department of Health to construct a sewer, capital debt for emergency purposes such as fire, flood or other disaster, the refunding of floating debt with the consent of the State Funding Commission, and the incurring of general debt based on the amount of debt retired in a prior year. The latter is a limited power provided by statute to take care of cases where certain capital expenditures should be incurred which do not fall in any of the exempted classifications. A municipality may incur debt in excess of statutory limitations if it has been found by the State Department of Health, and an order issued, that the expenditure is necessary to protect the public health and to prevent or suppress a present menace to the public health of sufficient gravity to justify the incurrence of the debt, and that no less expensive method of preventing or suppressing such menace exists.

New Jersey also has statutes under which sewer districts within a municipality or covering a complete municipality or two or more municipalities may be formed. The State also has a sewer rental law, under which sewerage works may be constructed and maintained as separate entities within

other local government structures. The State also has a sewerage authority law. Sewerage authorities may encompass a part of a municipality, a total municipality or two or more municipalities. Sewerage authorities are separate entities which operate, after appointment, independently of the local governing body.

The Anti-pollution Laws of Pennsylvania contain provisions relating to the financing of the construction of municipal sewage treatment plants. Municipalities which are ordered to construct sewage treatment plants and do not have sufficient funds on hand must acquire such funds through a bond issue. If direct obligation bonds cannot be issued because of constitutional debt limitations or failure to get consent of the electors financing can be done by the establishment of a Municipal Authority to construct, improve, maintain and operate sewers and sewage treatment works. A Municipal Authority is created by the governing body of the governmental subdivision by passage of an ordinance and the members of the Authority are appointed by the governing body which creates the Authority.(5) The existence of an Authority is limited to 50 years and it must procure a charter from the State before it can operate. In such cases a system of sewer rental charges is practically always adopted as the method for financing the sewage treatment facilities. The Pennsylvania Supreme Court in a recent case ruled that Municipal Authorities may assess charges against adjoining property owners to defray the expense of building a sewer. Financing of industrial waste treatment facilities is entirely the responsibility of the industry. In the case of the marginal industry operating in keen competition, the cost of treatment facilities is sometimes a major item of expense.

Other Measures in Effect

Soil erosion is moderate in several portions of the area covered in this report. Moderate sheet erosion exists in a portion of Chester and Delaware Counties in Pennsylvania and northern Delaware. In Zone 4 in New Jersey moderate sheet and slight wind erosion with occasional gullies exist. Soil conservation districts have been established in the New Jersey section of the basin, in Chester County, Pennsylvania and New Castle County, Delaware. Through the activities of the State Extension Services and the U. S. Soil Conservation Service progress is being made in soil and forest conservation. The agencies chiefly responsible for better forest conservation are the State forestry departments, namely, the Delaware State Forest Commission, the Pennsylvania Department of Forests and Waters and the New Jersey Department of Conservation and Economic Development, Division of Forestry. Incodel in cooperation with these agencies is active in the development of conservation projects particularly on the small watersheds in the area. The Brandywine Valley Association has been largely instrumental in educating the populace and furthering these activities in the Brandywine area.

(5) Financing Sewage Treatment Works - Pamphlet issued by the Sanitary Water Board, Pennsylvania Department of Health.

The Interstate Commission on the Delaware River Basin has no enforcement powers. It is engaged in the formation and execution of a coordinated, unified plan looking toward the wise use, development, and control of the resources of the Delaware River Basin as a whole. Through its cooperation with Federal, State and numerous local agencies and organizations substantial strides are being made in the pollution control program in Zone 4 of the Delaware River Basin. Effective educational work is carried on to acquaint the public with the problems to be solved and procedures for accomplishing the control of pollution and development of the overall program in the basin.

In Pennsylvania the Sanitary Water Board has an extensive educational program underway to enlist the support of the public and industry in the Board's program to control pollution of the streams. This activity is conducted through the use of periodicals, colored posters, mailing leaflets, special articles for technical publications, motion pictures, radio, press, working models of installations, the extensive use of photographs and by participation in meetings of civic, technical and other educational groups.

In Delaware the Water Pollution Commission in addition to its formal activities also carries on an extensive public information program. This is done by displays at special events, talks before various groups by Commission members and staff, newspaper releases, radio programs, technical journal publications, river basin reports and wide distribution of annual reports and other literature. Through the State Superintendent of Public Instruction, copies of the Mark Trail Adventure in Public Health and Conservation were distributed to Delaware grade school children.

The Brandywine Valley Association has been mentioned previously in various sections of the report. This is a private citizens group which has been formed to protect and conserve the natural resources of the valley. Specifically, the Brandywine Valley Association, Inc., is engaged in encouraging and aiding the people of the Brandywine Valley to reduce soil erosion and silting, lessen flood and drought damage, decrease stream pollution, improve and protect existing woodland, reforest marginal lands, and preserve wildlife and natural beauty. The Association cooperates with industry and communities in helping them to obtain good water and to solve waste problems. Assistance is given land owners in securing the services of conservation agencies in putting conservation programs into effect. Silting and stream flow are studied in order to provide valuable factual data helpful in controlling erosion, flooding and drought, and in measuring progress made in their control. The Association also encourages the cleaning and stocking of the Brandywine for fishing and advocates tree planting and sound woodland management. This unique organization, deriving all its funds from private contributions and relying solely on education without any legal authority, has had great success in awakening the people of the Brandywine Valley to their water resources problems and in helping solve them.

POLLUTION PREVENTION MEASURES NEEDED

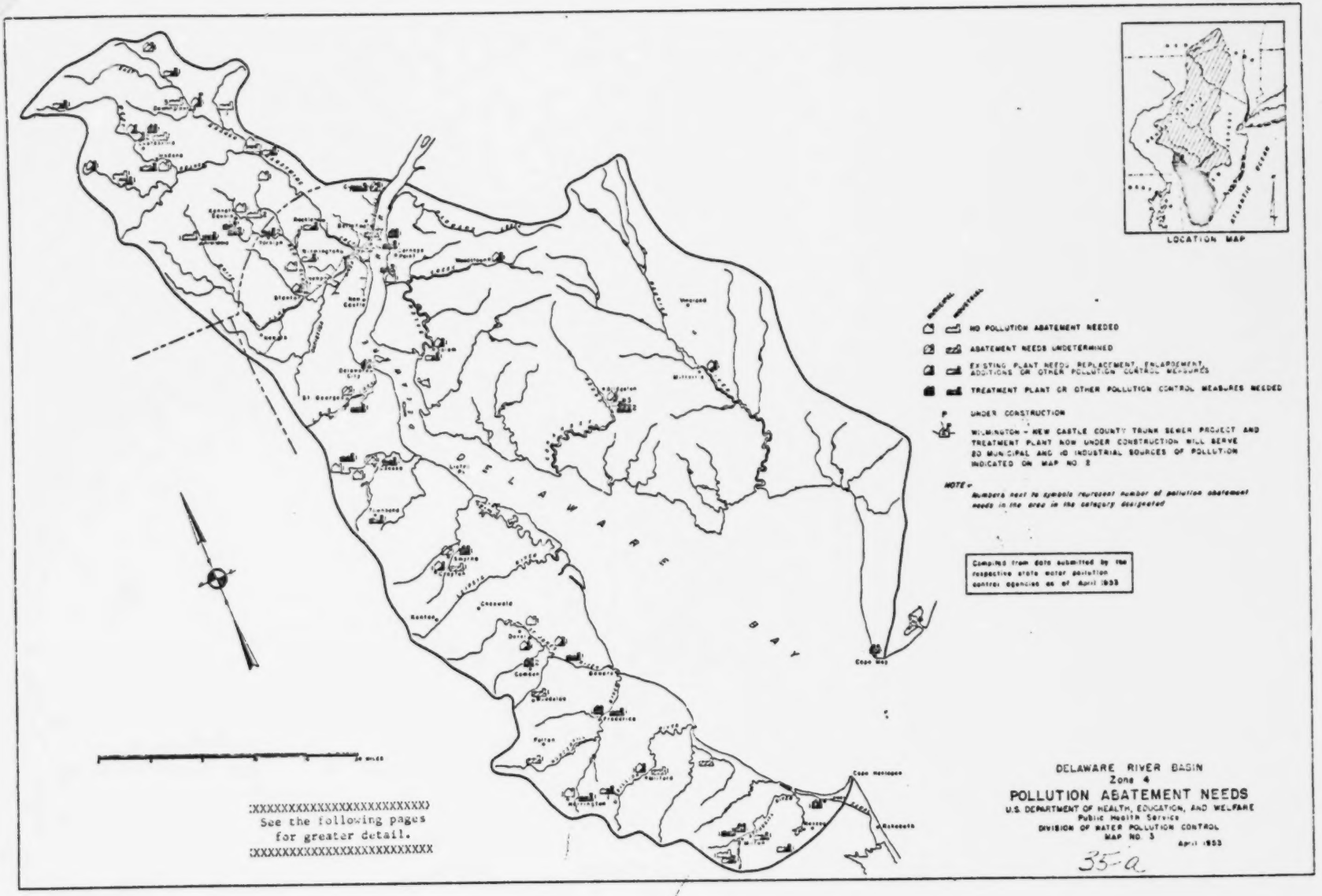
New sewage treatment plants are needed for 11 municipal sources of pollution carrying the wastes from 14,000 people which discharge raw sewage into the streams of Zone 4. In addition 20 municipalities with a sewered population of 165,650 plan to connect to the Wilmington-New Castle trunk sewer system. Of this group, at present, nine have sewage treatment facilities which will be abandoned after connection is made. Enlargements or additions to existing facilities are needed at 11 other municipal treatment plants which serve 85,700 people. Three municipalities with sewered populations of 10,000 need to replace their presently inadequate minor facilities. The sewage treatment works of 10 municipalities serving 17,200 people are considered adequate and no projects are needed. The pollution prevention needs of 2350 people in five small communities have not been determined. (See Table F.)

There are 18 industries in the Basin discharging untreated wastes to watercourses which need new waste treatment plants or internal process changes to abate their discharges. In addition to the municipalities previously mentioned, 10 industrial plants will connect to the Wilmington-New Castle County trunk sewer system. Four of these will abandon their present treatment facilities. There are nine industrial waste treatment plants which need enlargement or additions to their facilities and six which need replacement. No projects are needed at 12 plants which are considered adequate while the needs of six industrial plants have not been determined. (See Table G.)

Considerable advancement has been made in the program for control of pollution in Zone 4 of the Delaware River Basin. Rapid progress is being made toward completion of the Wilmington-New Castle County trunk sewer system. The contemplated completion date for the entire project is in the fall of 1954, an estimated 50% being completed as of January 1953. The cost for the City of Wilmington is in the neighborhood of $9 million of the approximate total cost of $14.5 million. The difference of $5.5 million is to be borne by New Castle County. This project involves approximately 65% of Delaware's population and 45% of its industry. The project consists basically of five large intercepting sewers collecting all of Wilmington's waste discharges and seven long trunk sewer lines to various developed areas in the County, such as Newark, New Castle, New Castle Airport and Newport. All wastes are to be collected and treated, before discharge into the Delaware River, at a primary sewage treatment plant now under construction in the Wilmington area.

Pollution abatement needs are shown on Map No. 3.

Major progress has already been accomplished in the Pennsylvania Section of Zone 4. All municipal discharges, except two, receive secondary treatment. When Parkesburg completes the additions to its primary plant for which plans are under preparation and South Coatesville carries out its program, all sewage will receive secondary treatment. Recently Downingtown constructed additions to its plant and West Chester built a new secondary plant on Taylor Run.


LOCATION MAP
NO POLLUTION ABATEMENT NEEDED
ABATEMENT NEEDS UNDETERMINED
EXISTING PLANT NEEDS REPLACEMENT, ENLARGEMENT, ADDITIONS OR OTHER POLLUTION CONTROL MEASURES
TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES NEEDED
P UNDER CONSTRUCTION
WILMINGTON - NEW CASTLE COUNTY TRUNK SEWER PROJECT AND TREATMENT PLANT NOW UNDER CONSTRUCTION WILL SERVE 20 MUNICIPAL AND 10 INDUSTRIAL SOURCES OF POLLUTION INDICATED ON MAP NO 2
NOTE -
Numbers next to symbols represent number of pollution abatement needs in the area in the category designated
Compiled from data submitted by the respective state water pollution control agencies as of April 1953
DELAWARE BAY
Cape May
Cape Henlopen
Rehoboth
Dover
Camden
Woodstown
Millville
Vineland
Hammonton
Atlantic City
Ocean City
Wildwood
Cape May
20 miles
XXXXXXXXXXXXXXXXXXXXXXXXX
See the following pages
for greater detail.
XXXXXXXXXXXXXXXXXXXXXXXXX

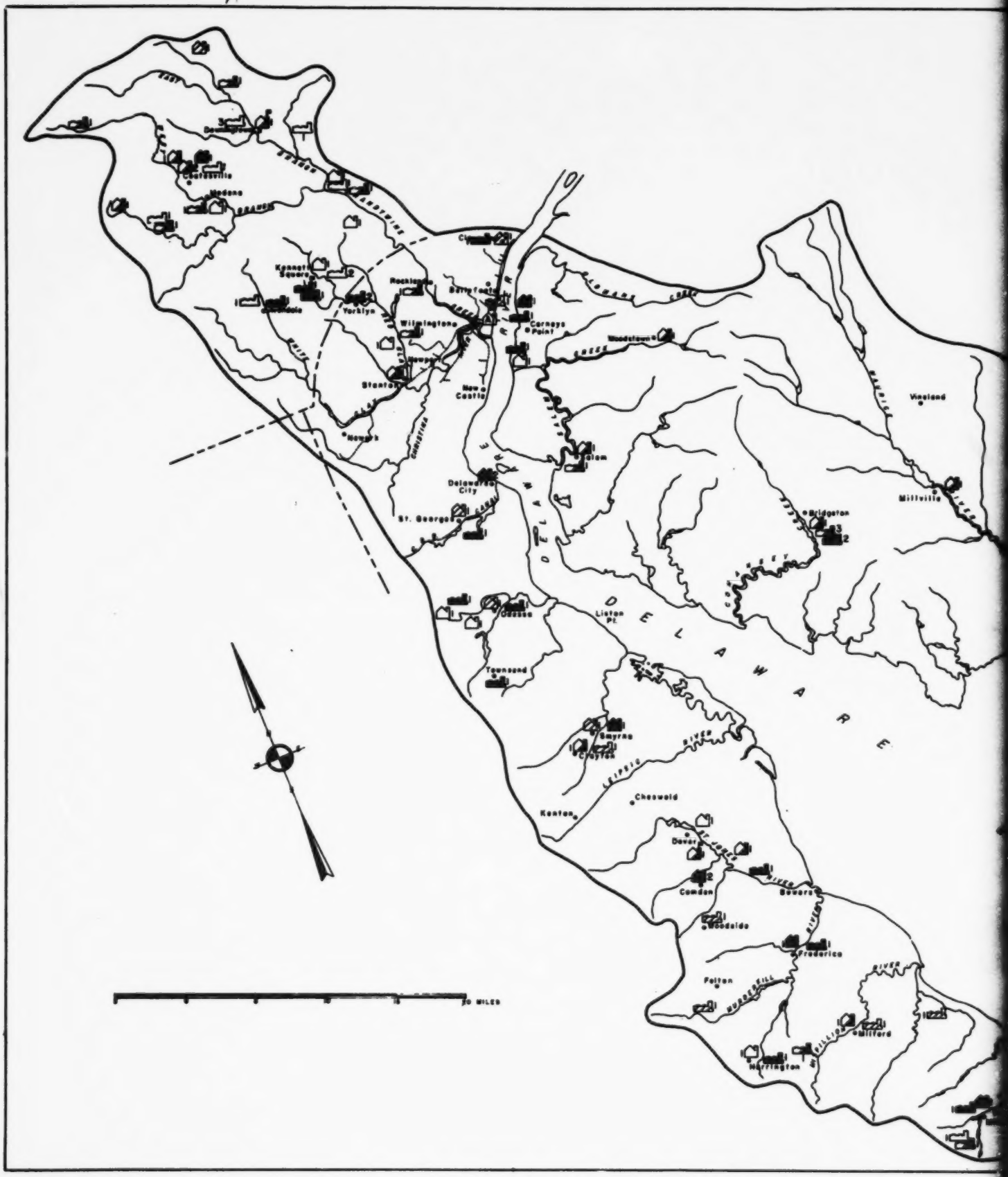
DELAWARE RIVER BASIN
Zone 4

POLLUTION ABATEMENT NEEDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 3 April 1953

35-a

A


DELAWARE
Wilmington
Newport
Stanton
New Castle
Delaware City
St. George's
Odessa
Townsend
Middletown
Smyrna
Clayton
Leipsic River
Cheswold
Kenton
Dover
Camden
Wyoming
Woodside
Frederica
Felton
Milford
Harrington
Viola
Milltown
Bridgeton
Vineland
Liston Pt
Cornays Point
Rockland
Yorklyn
Kennett Square
Landenberg
Hockessin
Marshallton
Centerville
Greenville
Montchanin
Christiana River
Red Lion Creek
Appoquinimink River
Murderkill River
Mispillion River
Broadkill River
Maurice River
Cohansey River
Salem River
Nanticoke River
Choptank River
Pocomoke River
Indian River
Rehoboth Bay
Little Assawoman Bay
Assawoman Bay
Isle of Wight Bay
Sinepuxent Bay
Newport Bay
Chincoteague Bay
Metompkin Bay
Cedar Island
Wachapreague
Quinby
Oyster Harbor
Nassawadox
Cape Charles
Cape Henry
Virginia Beach
Norfolk
Portsmouth
Suffolk
Chesapeake
Hampton
Newport News
Williamsburg
Yorktown
Gloucester
Mathews
Urbanna
Tappahannock
Kilmarnock
Irvington
Lancaster
Warsaw
Montross
Colonial Beach
Oak Grove
Dahlgren
Fredericksburg
Stafford
Quantico
Dumfries
Manassas
Alexandria
Arlington
Falls Church
Fairfax
Vienna
Herndon
Leesburg
Middleburg
Upperville
Paris
Berryville
Winchester
Front Royal
Strasburg
Woodstock
Edinburg
Mount Jackson
New Market
Harrisonburg
Broadway
Timberville
Bridgewater
Dayton
Staunton
Waynesboro
Fishersville
Crozet
Charlottesville
Scottsville
Gordonsville
Orange
Culpeper
Warrenton
Bealeton
Remington
Rappahannock River
Rapidan River
Hazel River
Robinson River
Rappahannock
Shenandoah River
Potomac River
Occoquan River
Bull Run
Cedar Run
Goose Creek
Broad Run
Catoctin Creek
Monocacy River
Opequon Creek
Cacapon River
Great Cacapon
Little Cacapon
Back Creek
Sleepy Creek
Tuscarora Creek
Conococheague Creek
Antietam Creek
Licking Creek
Fulton
Bedford
Hancock
Cumberland
Frostburg
Oakland
Grantsville
Accident
Deep Creek Lake
Swanton
Kitzmiller
Terra Alta
Rowlesburg
Kingwood
Aurora
Oakland
Elkins
Buckhannon
Weston
Clarksburg
Fairmont
Morgantown
Grafton
Philippi
Belington
Elkins
Webster Springs
Sutton
Flatwoods
Gassaway
Summersville
Richwood
Cowen
Rainelle
Lewisburg
White Sulphur Springs
Ronceverte
Hinton
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Union
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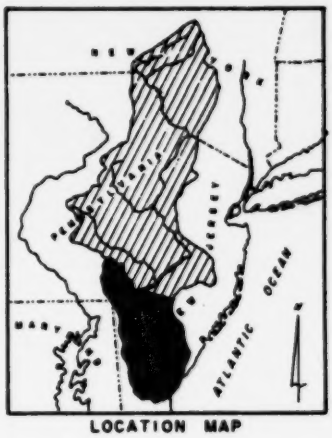
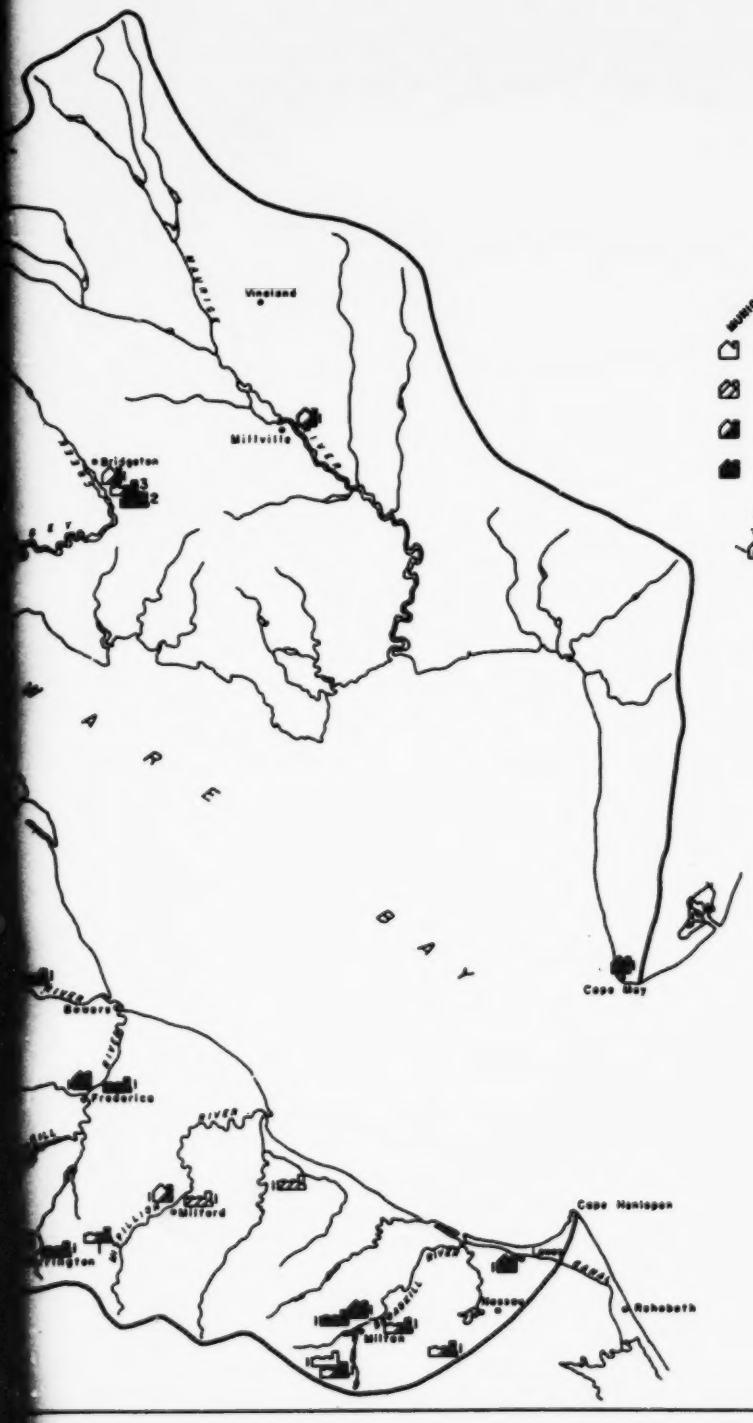
Alderson
Union
Lewisburg



LOCATION MAP



MUNICIPAL INDUSTRIAL

NO POLLUTION ABATEMENT NEEDED

ABATEMENT NEEDS UNDETERMINED

EXISTING PLANT NEEDS REPLACEMENT, ENLARGEMENT, ADDITIONS OR OTHER POLLUTION CONTROL MEASURES

TREATMENT PLANT OR OTHER POLLUTION CONTROL MEASURES NEEDED

P UNDER CONSTRUCTION

WILMINGTON - NEW CASTLE COUNTY TRUNK SEWER PROJECT AND TREATMENT PLANT NOW UNDER CONSTRUCTION WILL SERVE 20 MUNICIPAL AND 10 INDUSTRIAL SOURCES OF POLLUTION INDICATED ON MAP NO. 2

NOTE - Numbers next to symbols represent number of pollution abatement needs in the area in the category designated

Compiled from data submitted by the respective state water pollution control agencies as of April 1953

DELAWARE RIVER BASIN
Zone 4

POLLUTION ABATEMENT NEEDS

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
DIVISION OF WATER POLLUTION CONTROL
MAP NO. 3
April 1953

35-a

TABLE F

DELAWARE RIVER BASIN - ZONE 4

Waste Treatment Needs

April 1953

Municipal*

Needs	Number of Sources	Population Served by Facilities
New Plant	11	14,000
Connect to Trunk Sewer System	20 (a)	165,650 (a)
Enlargement or Additions to Existing Plant	11	85,700
Replace Existing Plant	3	10,000
No Project Needed	10	17,200
Undetermined	5	2,350
TOTAL	60	294,900

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns; significant institutions, resorts, recreational centers or other population centers.

(a) Includes four primary and five secondary treatment plants serving a total population of 39,400 which will be abandoned and connected to the Wilmington-New Castle County trunk sewer system.

TABLE G

DELAWARE RIVER BASIN - ZONE 4

Waste Pollution Abatement Needs

April 1953

Industrial*

Needs	Number
New Treatment Plant or Other Pollution Control Measures	18
Connection to Trunk Sewer Systems	10 (a)
Enlargement or Additions to Existing Plant	9
Replace Existing Plant	6
No Project Needed	12
Undetermined	6
TOTAL	61

* Industries having separate outlets discharging wastes directly to watercourse.

(a) Includes four industrial plants having treatment facilities at present which will be abandoned and 6 industrial plants with no treatment facilities. All will connect to the Wilmington-New Castle County trunk sewer system.

The industrial picture in Pennsylvania also shows that great progress has been made. All industrial plants which discharge wastes to waterways, except for three canneries, have some type of waste treatment facilities. One of these has facilities now under construction and the other two are planning to construct them in the near future.

A summary of the current status of municipal action on pollution abatement needs indicates that of 45 municipal sources of pollution in 41 municipalities which need new facilities or improvements, facilities now under construction will satisfy the needs of 22 sources. This construction will serve a population of 177,650. Fourteen municipalities with 16 sources of pollution, and a population of 75,850, are in the planning stage or have final plans approved. Seven communities with 21,850 population are inactive or their action is undetermined. (See Table H.)

A similar summary of the 43 industrial plants in Zone 4 with waste treatment needs indicates that 11 plants have new facilities under construction, 23 are actively planning for new facilities, and one has its final plans approved. The actions taken by eight plants are undetermined. (See Table I.)

It should be noted that 18 of the municipalities, with a sewered population of 135,650, and 10 of the industrial plants which are listed as being under construction are connecting to the Wilmington-New Castle County trunk sewer system.

A list of the municipalities and industries needing improvements as of April 1953 for abatement of pollution in Zone 4 of the Delaware River Basin are set forth in Table J. Basic data as of the same date on the sources of municipal and industrial pollution entering Zone 4 are presented in Tables 1 and 2 of the Appendix.

TABLE H

DELAWARE RIVER BASIN - ZONE 4

Status of Municipal* Action on Pollution Abatement Needs

April 1953

Status of Action	Number of Municipalities	Population Served by Facilities
Inactive or Undetermined	7 (7 sources)	21,850
Active Planning**	8 (8 sources)	45,600
Final Plans Approved***	6 (8 sources) (a)	30,250
Under Construction	20 (22 sources) (b,c)	177,650
TOTAL	41 (45 sources)	275,350

* Includes incorporated or unincorporated municipalities, other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers, or other large population centers.

** Includes preliminary action such as securing engineering services, making survey, preparing plans, arranging for purchase of site, developing financial program, studying means for additional treatment, or consideration of joint treatment with industry or other municipalities.

*** Includes plans approved by State Water Pollution Control Agency or final plans submitted to said Agency for approval.

(a) Includes three sources from South Coatesville, Pennsylvania

(b) Includes three sources from Wilmington, Delaware

(c) Includes 18 municipalities (20 sources) with a sewered population of 135,650 which will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

TABLE I

DELAWARE RIVER BASIN - ZONE 4

Current Status of Industrial* Action on
Pollution Abatement Needs

April 1953

Status of Action	Number of Industries
Inactive	-
Active Planning**	23
Final Plans Approved***	1
Under Construction	11 (a)
Undetermined	8
TOTAL	43

* Industries having separate outlets discharging wastes directly to watercourse.

** Includes preliminary action such as securing engineering services, making survey, preparing plans, arranging for purchase of site, developing financial program, studying need for additional, joint or pre-treatment, pilot plant operation, internal process changes, or negotiations with municipality to enter municipal sewer system.

*** Includes plans approved by State Water Pollution Control Agency, final plans submitted to said Agency for approval or permission granted by municipality for connection to municipal sewer system.

(a) Includes 10 industrial plants which will be served by the Wilmington-New Castle trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River

TABLE J

DELAWARE RIVER BASIN - ZONE 4

Municipalities and Industries Needing Improvements for Abatement of Pollution*

April 1953

Delaware

(Barkers Landing)
Barkers Landing Canning Co.

Bellefonte**

Bellevue**

Camden

Clayton

Claymont**
Worth Steel Co.

Delaware City
Gov. Bacon Health Center

Dover**
U. S. Air Force Base

(Farnhurst)
Delaware State Hospital**

Frederica
C. Draper Bros. Cannery

(Georgetown)
J. G. Townsend Canning Co.

(Harbeson)
Paramount Poultry Co.

(Harrington)
Harrington Canning Co.

(Houston)
Libby, McNeill & Libby Co.

Lewes

Marshallton**
Continental Diamond Fibre Co.**
Hercules Experiment Station

(Middletown)
Cole Canning Co.

Milford

Milton
Draper's Cannery
Milton Poultry Co.

Newark**
Chrysler Corp.**
Curtis Paper Co.**
National Vulcanized Fibre Co.**
Phillips Cannery**

New Castle**

New Castle County**
New Castle Co. Airport**
New Castle Co. Workhouse**
Red Clay Creek Treatment Plant**
Shellpot Creek Treatment Plant**

Newport**
Krebbs Pigment Co.**
Wood Preserving Co.**

(Odessa)
Wadkins Canning Co.

Richardson Park**

(Rockland)
Doeskin Products Co.

(St. Georges)
St. Georges Canning Co.

Smyrna

Stanton**
Delaware Race Track

(Townsend)
Phillips Packing Co.

Wilmington**
Jos. Bancroft and Co.**
Container Corp. of America**
DuPont Country Club**
DuPont Experiment Station**
Shellpot Creek Treatment Plant**
Woodcrest**
Worthland**

Wyoming

(Yorklyn)
Marshall Bros., Inc.
National Vulcanized Fibre Co.

New Jersey

Bridgeton
Wm. Laning & Son Co.
Martin Dyeing & Finishing Co.
E. Pritchard, Inc.
Rainers Dairy
P. J. Ritter Co.

(Carneys Point)
E. I. duPont de Nemours & Co.

Cape May

(Deepwater)
E. I. duPont de Nemours & Co.

Millville

Penns Grove

Salem
H. J. Heinz Co.

Woodstown

Pennsylvania

(Avondale)
Superior Canning Co.

(Caln Twp.)
Eagle Paper Co.

Coatesville

Downingtown**

(Honeybrook)
Tri-County Dairy Farms

(Kennett Twp.)
J. B. Swayne & Sons, Inc.

(Modena)
Beach & Arthur Paper Co.

(New Garden Twp.)
Vincent Losita & Sons**

Parkesburg

South Coatesville

(West Goshen)
Willow Brook Packing Co.

(West Marlborough Twp.)
Highland Dairy Products Co., Inc.

* For details see Tables 1 and 2. This table does not include municipalities or industries listed with needs undetermined.
** Needed improvements are under construction.
( ) Municipalities enclosed by parenthesis are not in need of improvements and only indicate the location of the industry or institution cited.

BASIC DATA TABLES

The data as of April 1953 listed on the following Basic Data Tables were reported by the Delaware Water Pollution Commission and State Board of Health, New Jersey Department of Health and the Sanitary Water Board of the Pennsylvania Department of Health. They are arranged by watershed area which enables the reader to isolate, for any particular area, the amounts and kinds of pollution being discharged and the adequacy of treatment where provided. The Delaware River is listed first, starting with the sources of pollution farthest upstream and continuing down to its mouth at Liston Point. Each tributary along with its branches is then covered in downstream order. Streams emptying into Delaware Bay are listed separately from north to south on the New Jersey shore and on the Delaware shore. Those tributaries which receive no pollution are not listed, while those receiving municipal pollution will be found in Table 1 (Municipal) and similarly, those receiving industrial pollution in Table 2 (Industrial).

The reader is cautioned not to assume the entries as listed to be final. Changing conditions in water uses, pollution contributed, stream quality, information obtained during surveys and other circumstances, may dictate readjustments.

Table 1 applies to municipalities. Included, but not listed, are those industries discharging wastes into municipal sewers. Table 2 applies only to industries discharging directly to a watercourse.

To aid in finding the location of the various sources of pollution, a stream code and river mileage system has been devised. Each of the pollution points on any stream is listed in downstream order beneath the name of that stream, accompanied by its distance in river miles from the mouth of the stream. Tributary streams are further identified by a symbol indicating the stream to which they are tributary and a mileage number indicating in river miles the point at which they join the larger stream. With this information any source of pollution may be located with respect to the mouth of the main stream of the Basin. No mileage system has been used on Delaware Bay.

Example: To locate the outfall of Newark, Delaware listed in Table 1. It is found that Newark discharges to White Clay Creek at a point about 7.0 miles from its mouth. White Clay Creek (C-10.1) enters the Christina River at a point 10.1 miles from its mouth. The Christina River (D-22.6) flows into the Delaware River at a point 22.6 miles from its mouth at Liston Point, Delaware which has been established as the zero point for the Delaware River system. Accordingly, Newark, Delaware is 39.7 stream miles above the mouth of the Delaware River at Liston Point.

Stream Code
Zero Mileage - Liston Point, Del. and Hope Creek, N. J. dividing line between Delaware River and Delaware Bay

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
DELAWARE RIVER							
Claymont, Del.	30.2	1700	N	None	N	Connect to trunk sewer	Under construction (a)
Bellevue, Del.	26.5	2000	N	None	N	Connect to trunk sewer	Under construction (a)
Bellefonte, Del.	26.0	1500	N	None	N	Connect to trunk sewer	Under construction (a)
Penns Grove, N. J.	23.5	N	N	None	N	New Plant	Active planning; no central system; septic tanks connected to storm sewers.
Wilmington, Del.	22.3	-	(See Footnote c.)				
Deepwater Operating Co., Lower Penns Neck Twp., N. J.	21.0	250	N	Primary	150	None	-
New Castle, Del.	17.3	5400	N	None	N	Connect to trunk sewer	Under construction (a)
Delaware City, Del.	9.5	1350	N	None	N	New Plant	Undetermined (b)

N - Unknown, P.E. - Population Equivalent, B.O.D. - Biochemical Oxygen Demand, E - Estimated

* Includes incorporated or unincorporated municipalities; other legal bodies as sanitary districts, counties, towns, significant institutions, resorts, recreational centers or other population centers.

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

(b) Under preliminary investigation by Delaware Water Pollution Commission.

(c) New Wilmington primary plant now under construction to serve Wilmington-New Castle Co. trunk sewer system.

Stream Code

D - Delaware River

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
DELAWARE RIVER							
Gov. Bacon Health Center, Delaware City, Del.	9.3	500	N	None	N	New Plant	Undetermined (b)
NAAMANS CREEK	D-34.0						
Woods Haven School, Claymont, Del.	4.0	50	N	Secondary	N	Undetermined	-
Worthland, Del.	0.5	100	N	None	N	Connect to trunk sewer	Under construction (a)
CHRISTINA RIVER	D-22.6						
Newport, Del.	9.3	1150	N	None	N	Connect to trunk sewer	Under construction (a)
New Castle County Airport, Del.	8.0	3000	N	Primary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
Woodcrest, Del.	6.3	500	N	None	N	Connect to trunk sewer	Under construction (a)
Delaware State Hospital, Farnhurst, Del.	6.0	1500	N	Primary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

(b) Under preliminary investigation by Delaware Water Pollution Commission.

Stream Code
C - Christina River (D-22.6)
W - White Clay Creek (C-10.1)

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
CHRISTINA RIVER (cont.)							
Richardson Park, Del.	5.8	15,000	N	Secondary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
Wilmington, Del.	0.5	61,400	N	None	N	Connect to trunk sewer	Under construction (a)
WHITE CLAY CREEK	C-10.1						
Newark, Del.	7.0	6700	N	Secondary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
Delaware Race Track, Stanton, Del.	1.0	100E	N	Primary	N	Additions	Undetermined, may enter Wilmington-New Castle Co. trunk sewer system
Red Clay Creek Treatment Plant, New Castle Co., Del.	0.1	4100	N	Primary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
RED CLAY CREEK	W-2.6						
New Castle Co. Workhouse, Cedars, Del.	2.5	400E	N	Minor	N	Connect to trunk sewer	Under construction (a)

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
W - White Clay Creek (C-10.1)
R - Red Clay Creek (W-2.6)

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
RED CLAY CREEK (cont.)	W-2.6						
Marshallton, Del.	1.7	100	N	None	N	Connect to trunk sewer	Under construction (a)
Stanton, Del.	0.8	800	N	Primary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
WEST BRANCH RED CLAY CREEK	R-20.0						
Kennett Square, Pa.	12.0	3400	N	Secondary	N	None	-
HYDE RUN							
Brandywine Sanitarium, Del.	2.0	500	N	Secondary	N	None	-
BRANDYWINE CREEK	C-0.5						
DuPont Country Club, Wilmington, Del.	3.0	300E	N	Secondary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
Wilmington, Del.	0.5	52,000	N	None	N	Connect to trunk sewer	Under construction (a)

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
B - Brandywine Creek (C-0.5)
Be - East Branch Brandywine Creek (B-19.8)

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
EAST BRANCH BRANDYWINE CREEK	B-19.8						
Downingtown, Pa.	8.0	5000	N	Secondary	750	Additions	Under construction Partially completed in 1952
MARSH CREEK	Be-12.0						
Penn Turnpike Station, Gulf Oil Corp., Wallace Twp., Pa.	4.0	1200E	N	Secondary	N	Undetermined	Plant completed in 1952
TAYLOR RUN	Be-3.0						
West Chester, Pa.	1.0	7500	N	Secondary	1800	None	Plant completed in 1952
WEST BRANCH BRANDYWINE CREEK	B-19.8						
City of Coatesville, Pa.	15.6	18,000	N	Secondary	5400	Additions	Active planning-Under S.W.B. order for additional works
South Coatesville Borough, Dist. #1, Pa.	15.0	400	N	Secondary	N	Replacement	To be served by South Coatesville Borough, Dist. #4, treatment works; present treatment works to be abandoned
South Coatesville Borough, Dist. #2, Pa.	14.9	400	N	Secondary	N	Replacement	Under S.W.B. order to construct; to be served by South Coatesville Borough, Dist. #4, treatment works; present treatment works to be abandoned

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Stream Code
B - Brandywine Creek (C-0.5)
Bw - West Branch Brandywine Creek (B-19.8)

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
South Coatesville Borough, Dist.#4, Pa.	14.7	2700	N	None	N	New Plant	Final Plans Approved. Will serve Districts #1, 2, 3 and 4.
Embreeville State Hosp., Newlin Twp., Pa.	7.2	750	N	Secondary	300	None	-
BUCK RUN	Bw-10.4						
Parkesburg, Pa.	11.5	2300	N	Primary	N	Additions	Under S.W.B. order; secondary treatment needed.
POCOPSON CREEK	B-10.0						
Chester Co. Hospital for the Aged, Pocopson Twp., Pa.	1.0	200	N	Secondary	N	None	Plant completed in 1950
SHELLPOT CREEK	B-0.6						
Shellpot Creek Treatment Plant, New Castle Co., Del.	0.8	3000	N	Secondary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned
Shellpot Creek Treatment Plant, Wilmington, Del.	0.2	5000	N	Secondary	N	Replacement-connect to trunk sewer	Under construction (a) Existing plant to be abandoned

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
Db - Delaware Bay

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
CHESAPEAKE & DELAWARE CANAL	D-11.6						
St. Georges, Del.	4.5	350	N	None	N	Undetermined	-
SALEM CREEK							
Woodstown, N. J.	13.0	2200	2200	Secondary	1050	Enlargement	Active Planning
Salem, N. J.	1.0	9200	N	Minor	9050	Replacement	Active Planning
APPOQUINIMINK CREEK	D-30						
Middletown, Del.	13.0	1750	N	Secondary	N	None	-
St. Andrews School, Del.	9.0	200	N	Secondary	N	None	-
Odessa, Del.	7.5	450	N	None	N	Undetermined	-
DELAWARE BAY NEW JERSEY SHORE							
Cape May, N. J.	-	2600	N	None	N	New Plant	Active planning-also serves Cape May Point and West Cape May.
COHANSEY RIVER	Db						
Bridgeton, N. J.	8.0	13,300	13,900	Secondary	4300	Enlargement	Active planning

Stream Code
Db - Delaware Bay
S - St. Jones River

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
DELAWARE BAY NEW JERSEY SHORE (cont.)							
MAURICE RIVER Milleville, N. J.	Db 8.0	16,800	7,900	Primary	5,200	Additions	Undetermined
DELAWARE BAY DELAWARE SHORE							
SMYRNA RIVER Clayton, Del.	Db 14.1	800	N	Primary	600	Additions	Undetermined
State Welfare Home, Smyrna, Del.	10.8	300	N	Primary	250E	Undetermined	-
Smyrna, Del.	10.6	2350	N	None	N	New Plant	Final plans approved
ST. JONES RIVER	Db						
Delaware State College, Dover, Del.	19.6	400	N	Secondary	100	None	-
Dover, Del.	16.5	7000	N	Primary	3900	Additions	Under construction
Dover Air Force Base, Del.	12.0	15,000	N	Primary	N	Additions	Final plans approved
ISAACS BRANCH Wyoming, Del.	S-13.0 3.6	250	250	None	250	New Plant	Active planning 25% sewered

Stream Code
Db - Delaware Bay
M - Murderkill River

TABLE 1

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Municipal* Pollution

April 1953

Name and Location	River Mile Above Mouth	Population Served by Sewers	P.E. (B.O.D.) Untreated Wastes	Waste Treatment Provided	P.E. (B.O.D.) Discharged to Watercourse	Treatment Needs	Status, Remarks
ISAACS BRANCH (cont.)							
Camden, Del.	2.7	50	50	None	50	New Plant	Active planning; 10% sewered
MURDERKILL RIVER	Db						
Frederica, Del.	7.4	N	N	None	N	New Plant	Undetermined; no central sewer system
BROWNS BRANCH	M-11.0						
Harrington, Del.	8.0	2250	N	Primary	N	None	-
MISPILLION RIVER	Db						
Milford, Del.	12.7	5200	N	Primary	N	Additions	Final plans approved. Referendum to be held
BROADKILL RIVER	Db						
Milton, Del.	10.4	1300	N	None	N	New Plant	Final plans approved
LEWES & REHOBOTH CANAL	Db						
Lewes, Del.	1.0	2900	N	None	N	New Plant	Final plans approved

Stream Code
Zero Mileage - Liston Point, Del. and Hope Creek, N.J. dividing line between Delaware River and Delaware Bay

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
DELAWARE RIVER							
E.I. duPont de Nemours & Co., Edgemoor, Del.	24.0	Chemical	Inorganic	Minor	N	Undetermined	Partial neutralization provided
E.I. duPont de Nemours & Co., Carneys Point, N. J.	22.7	Chemical	Organic	None	15,100	New Plant	Active planning
E.I. duPont de Nemours & Co., Deepwater, N.J.	21.0	Chemical	Organic	None	1,600,000	New Plant	Active planning; uses compositing basin
NAAMANS CREEK	D-34.0						
Worth Steel Co., Claymont, Del.	0.5	Fabr. Metals	Inorganic	None	N	New plant or Connect to trunk sewer	Undetermined
CHRISTINA RIVER	D-22.6						
Phillips Cannery Newark, Del.	40.0	Food (Cannery)	Organic, San.Sewage	Primary	4200	Replacement-connect to trunk sewer	Under construction (a) Existing treatment works will be abandoned

N - Unknown, P.E. - Population Equivalent, B.O.D. - Biochemical Oxygen Demand, E - Estimated

* Industries having separate outlets and discharging wastes directly to watercourse.

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
D - Delaware River
C - Christina River (D-22.6)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
CHRISTINA RIVER (cont.)							
Chrysler Corp. Newark, Del.	40.0	Miscella-neous	Organic	Primary	550	Replacement - Connect to trunk sewer	Under construction (a) Existing treatment works will be abandoned
Wood Preserving Co. Newport, Del.	10.0	Lumber	Organic	Primary	1000E	Replacement - Connect to trunk sewer	Under construction (a) Existing treatment works will be abandoned
Krebbs Pigment Co. Newport, Del.	10.0	Chemical	Organic	Inter-mediate	14000E	Replacement - Connect to trunk sewer	Under construction (a) Existing treatment works will be abandoned
WHITE CLAY CREEK	C-10.1						
Seabrook Farms Co., Avondale Viner Station, London Grove Twp., Pa.	12.0	Food (Cannery)	Organic	Complete	N	None	Treatment works completed in 1950
Superior Canning Co., Avondale, Pa.	12.0	Food (Cannery)	Organic	None	N	New Plant	Active planning
National Vulcanized Fibre Co., Newark, Del.	6.9	Paper and Allied	Organic	None	26000E	Connect to trunk sewer	Under construction (a)
Curtis Paper Co., Newark, Del.	6.9	Paper and Allied	Organic	None	5000E	Connect to trunk sewer	Under construction (a)

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
W - White Clay Creek (C-10.1)
R - Red Clay Creek (W-2.6)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
RED CLAY CREEK	W-2.6						
Marshall Bros., Inc. Yorklyn, Del.	10.3	Paper and Allied	Organic	None	40,000	New Plant	Active planning
National Vulcanized Fibre Co., Yorklyn, Del.	9.4	Paper and Allied	Organic	None		New Plant	Active planning
Hercules Experiment Station, Marshallton, Del.	3.5	Chemical	Organic	Primary	8,650	Additions or connect to trunk sewer	Active planning
Continental Diamond Fibre Co., Marshallton, Del.	1.5	Paper and Allied	Organic	None	N	Connect to trunk sewer	Under construction (a)
WEST BRANCH RED CLAY CREEK	R-13.8						
Vincent Losita & Sons, New Garden Twp., Pa.	4.5	Food (Cannery)	Organic	None	N	New Plant	Complete treatment works under construction
National Vulcanized Fibre Co., Kennett Sq., Pa.	3.8	Paper and Allied	Organic	Complete	N	None	Treatment works completed in 1950
A. D. Pierce Co., Kennett Sq., Pa.	3.8	Food (Abattoir)	Organic	Complete	N	None	Treatment works completed in 1950

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
B - Brandywine River (C-0.5)
C - Christina River (D-22.6)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
WEST BRANCH RED CLAY CREEK (cont.)							
J.B. Swayne & Sons, Inc., Kennett Twp., Pa.	3.0	Food (Cannery)	Organic	None	N	New Plant	Active planning; S.W.B. notice to install complete treatment
BRANDYWINE RIVER	C-0.5						
Doeskin Products Co., Rockland, Del.	6.8	Paper and Allied	Organic	Minor	N	Additions	Active planning
DuPont Experiment Station, Wilmington, Del.	2.1	Chemical	San.Sewage Organic	None	1100	Connect to trunk sewer	Under construction (a)
Jos. Bancroft & Co., Wilmington, Del.	2.1	Textile	Organic	None	17,700E	Connect to trunk sewer	Under construction (a)
Container Corp. of America, Wilmington, Del.	2.1	Paper and Allied	Organic	None	N	Connect to trunk sewer	Under construction (a)
EAST BRANCH BRANDYWINE CREEK	B-19.8						
Eagle Paper Co., Caln Twp., Pa.	10.0	Paper and Allied	Organic	Complete	N	Additions	Active planning; under S.W.B. order
The Davey Co., Downingtown, Pa.	8.0	Paper and Allied	Organic	Recirculation closed system	-	None	No discharge

(a) Will be served by the Wilmington-New Castle County trunk sewer system now under construction and will receive primary treatment in Wilmington prior to discharge to the Delaware River.

Stream Code
B - Brandywine Creek (C-0.5)
Be - East Branch Brandywine Creek (B-19.8)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
EAST BRANCH BRANDYWINE CREEK (cont.)	B-19.8						
Downingtown Paper Co. Downingtown, Pa.	8.0	Paper and Allied	Organic	Intermediate	N	None	-
S. Austin Bicking Paper Co., Downingtown, Pa.	8.0	Paper and Allied	Organic	Intermediate	N	None	-
VALLEY CREEK	Be-4.4						
Atlantic Refining Co., West Whiteland Twp., Pa.	4.0	Petroleum and Coal Products	Organic	Secondary	N	None	-
TAYLOR RUN	Be-3.0						
Eachus Dairies, East Bradford Twp., Pa.	2.5	Food (Dairy)	Organic	Secondary	N	None	-
Willow Brook Packing Co., West Goshen, Pa.	2.2	Food (Abattoir)	Organic	Primary	N	Additions	S.W.B. order to install complete treatment; active planning
WEST BRANCH BRANDYWINE CREEK	B-19.8						
Tri-County Dairy Farms, Honeybrook, Pa.	28.3	Food (Dairy)	Organic	Minor	N	Replacement	S.W.B. order to install complete treatment; active planning
Lukens Steel Co., Coatesville, Pa.	15.4	Primary Metals	Inorganic	Primary	N	None	Treatment works completed in 1950

Stream Code
B - Brandywine River (C-0.5)
Bw - West Branch Brandywine Creek (Bw-10.4)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
WEST BRANCH BRANDYWINE CREEK (cont.)	B-19.8						
Keystone Mushroom Co., Valley Twp., Pa.	14.0	Food (Cannery)	Organic	Complete	N	None	-
Beach & Arthur Paper Co., Modena, Pa.	13.0	Paper and Allied	Organic	Complete	N	Additions	S.W.B. order for additional treatment works; active planning
BUCK RUN	Bw-10.4						
General Paper Co., Inc., Highland Twp., Pa.	7.0	Paper and Allied	Organic	Lagoon	-	None	No discharge
Highland Dairy Products Co., West Marlboro, Pa.	5.0	Food (Dairy)	Organic	Secondary	N	Additions	S.W.B. order to install complete treatment works; final plans approved
CHESAPEAKE AND DELAWARE CANAL	D-11.6						
St. Georges Canning Co., St. Georges, Del.	4.5	Food (Cannery)	Organic	None	850	New Plant	Undetermined
SALEM CREEK	D-8.2						
H. J. Heinz Co. Salem, N. J.	1.0	Food (Cannery)	Organic	Minor	18,600	Replacement	Active planning

Stream Code
Db - Delaware Bay
D - Delaware River

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
APPOQUINIMINK CREEK	D-3.0						
Cole Canning Co. Middletown, Del.	13.0	Food (Cannery)	Organic	None	400	New Plant	Undetermined
Wadkins Canning Co., Odessa, Del.	7.5	Food (Cannery)	Organic	None	7000E	New Plant	Undetermined; may connect to Odessa
DELAWARE BAY NEW JERSEY SHORE							
COHANSEY RIVER	Db						
Wm. Laning & Son Co., Bridgeton, N. J.	19.0	Food (Cannery)	Organic	Minor	2700	Replacement	Active planning
E. Pritchard, Inc. Bridgeton, N. J.	19.0	Food (Cannery)	Organic	Minor	44,150	Replacement	Active planning
P. J. Ritter Co. Bridgeton, N. J.	19.0	Food (Cannery)	Organic	Minor	44,750	Replacement	Active planning
Rainers Dairy Bridgeton, N. J.	19.0	Food (Dairy)	Organic	None	300	New Plant	Active planning
Martin Dyeing & Finishing Co., Bridgeton, N. J.	19.0	Textile	Organic	None	1400	New Plant	Active planning

Stream Code
Db - Delaware Bay
S - St. Jones River

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
DELAWARE BAY DELAWARE SHORE							
BLACKBIRD CREEK	Db						
Phillips Packing Co. Townsend, Del.	12.5	Food (Cannery)	Organic	None	1450	New Plant	Undetermined
SMYRNA RIVER	Db						
Wheatleys Canning Co., Clayton, Del.	14.1	Food (Cannery)	Organic	Primary	3700	Undetermined	-
ST. JONES RIVER	Db						
Barkers Landing Canning Co., Barkers Landing, Del.	6.8	Food (Cannery)	Organic	None	150	New Plant	Undetermined
TIDBURY CREEK	S-11.3						
Woodside Canning Co., Woodside, Del.	5.2	Food (Cannery)	Organic	None	100	Undetermined	-
MURDERKILL RIVER	Db						
Swift & Co. Felton, Del.	18.5	Food (Poultry)	Organic	Minor	3600E	Undetermined	-
C. Draper Bros. Cannery, Frederica, Del.	7.4	Food (Cannery)	Organic	None	150	New Plant	Active Planning

Stream Code
M - Murderkill River
Mi - Mispillion River (Db)
Br - Broadkill River (Db)
Db - Delaware Bay

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
BROWNS BRANCH	M-11.0						
Harrington Cannery Co., Harrington, Del.	8.0	Food (Cannery)	Organic	None	2300	New Plant	Undetermined
MISPILLION RIVER	Db						
Milford Packing Co. Milford, Del.	12.5	Food (Cannery)	Organic	None	N	Undetermined	-
BEAVERDAM BRANCH	Mi-6.5						
Libby, McNeil & Libby Co., Houston, Del.	2.0	Food (Cannery)	Organic	Minor	650	Additions	Active Planning
SLAUGHTER CREEK	Mi-0.5						
Geo. Draper Jr., Cannery, Slaughter Neck, Del.	5.0	Food (Cannery)	Organic	None	900	Undetermined	-
BROADKILL RIVER	Db						
Swift & Co. Georgetown, Del.	16.0	Food (Poultry)	Organic	Primary	1850	None	-
J.G. Townsend Canning Co., Georgetown, Del.	16.0	Food (Cannery)	Organic	Minor	1400	Additions	Active Planning
Drapers Cannery, Milton, Del.	10.4	Food (Cannery)	Organic	None	3600	New plant or connect to municipal sewer	Undetermined

Stream Code
Mi - Mispillion River (Db)
Br - Broadkill River (Db)

TABLE 2

DELAWARE RIVER BASIN - ZONE 4

Basic Data on Sources of Industrial* Pollution

April 1953

Name and Location	River Mile Above Mouth	Type of Industry	Type Waste Produced	Degree of Treatment	P.E. (B.O.D.) Discharged to Watercourse	Pollution Abatement Needs	Remarks, Status
BROADKILL RIVER (Cont.)							
Milton Poultry Co. Milton, Del.	10.4	Food (Poultry)	Organic	Primary	400	Replacement	Active planning; to enter municipal sewer system
BEAVERDAM CREEK	Br-6.2						
Paramount Poultry Co., Harbeson, Del.	6.0	Food (Poultry)	Organic	Primary	2650	Additions	Active planning; Extensive process changes in 1952

APPENDIX A

DELAWARE RIVER BASIN - ZONE 4

Summary of U.S. Geological Survey Stream Flow Records

Gaging Station	Years of Record	Drainage Area above Gaging Station, square miles	Average Daily Discharge, C.F.S.	Maximum Discharge		Minimum Discharge	
				Date	Flow, C.F.S.	Date	Flow, C.F.S.
Christina River at Cooches Bridge, Del.	1943-1949 (6 years)	20.5	-	5/1/47	2620	7/26/44	0.4
White Clay Creek near Newark, Del.	1931-36 1943-49 (10 years)	87.8	119	8/23/33	6230	9/18/32	9.1
Red Clay Creek at Wooddale, Del.	1943-1949 (6 years)	47.0	-	7/5/45	2810	8/29, 9/1, 9/3, 9/4/44	10.0
West Branch Brandywine Creek at Coatesville, Pa.	1943-1949 (6 years)	45.8	-	9/18/45	3670	9/10/44	4.6
Brandywine Creek at Chadds Ford, Pa.	1911-17 1918-49 (37 years)	287	379	3/5/20	17,200	10/2/41	4.9
Brandywine Creek at Wilmington, Del.	1946-1949 (2 years)	314	-	11/25/50	11,500	12/26/48	30
Shellpot Creek at Wilmington, Del.	1945-1949 (3 years)	7.46	-	5/1/47	2140	9/16-9/18/48	0.2
Salem Creek at Woodstown, N.J.	1941-1949 (8 years)	14.6	-	9/1/40	22,000	Many days	No flow

APPENDIX A

DELAWARE RIVER BASIN - ZONE 4

Summary of U.S. Geological Survey Stream Flow Records

Gaging Station	Years of Record	Drainage Area above Gaging Station, square miles	Average Daily Discharge, C.F.S.	Maximum Discharge		Minimum Discharge	
				Date	Flow, C.F.S.	Date	Flow, C.F.S.
Leipsic River near Cheswold, Del.	1931-33, 1943-49 (8 years)	9.2	-	8/23/33	374	8/19/31	0.9
Maurice River at Norma, N.J.	1932-1949 (17 years)	113	176	9/2/40	7360	9/25/32	27
Manantico Creek near Millville, N. J.	1931-1949 (18 years)	22.3	38.9	8/20/39	1050	8/16-8/18/36	1.4
Loper Run near Bridgeton, N.J.	1937-1949 (11 years)	2.34	1.39	9/1/40	94	Many days	No flow

APPENDIX B

DELAWARE RIVER BASIN - ZONE 4

Population Data

Municipalities, Townships and Rural Areas in Basin

Place	1950 Population	1940 Population	% Increase 1940-50
DELAWARE			
Kent Co.			
District #1	4,422	3,506	26.1
" #2	4,248	3,530	20.3
" #3 (70%*)	1,869	1,769	5.7
" #4 (60%*)	1,533	1,501	2.1
" #5	6,052	5,169	17.1
" #6 (10%*)	217	227	-4.6
" #7	3,838	3,745	2.5
" #8	3,269	3,200	2.2
" #9 (30%*)	1,326	1,286	3.1
" #10	4,229	3,700	14.3
Total-Kent Co. in Basin	31,003	27,633	12.2
New Castle Co.			
Wilmington			
District #1-5	110,356	112,504	-1.9
" #6	24,039	14,426	66.6
" #7	32,224	18,696	72.4
" #8	7,677	5,662	35.6
" #9	9,057	6,398	41.6
" #10	21,824	10,245	113.0
" #11 (80%*)	2,079	1,576	31.9
" #12	3,053	2,771	10.2
" #13 (85%*)	3,871	3,132	23.6
" #14 (85%*)	1,849	1,730	6.9
" #15 (95%*)	1,255	1,112	12.9
Total-New Castle Co. in Basin	217,284	178,252	21.9

* Estimated

APPENDIX B (Cont.)

Place	1950 Population	1940 Population	% Increase 1940-50
Sussex Co.			
District #1 (80%*)	5,803	4,749	22.2
District #10 (60%*)	6,041	4,881	23.8
Total-Sussex Co. in Basin	11,844	9,630	23.0
TOTAL - DELAWARE in Basin	260,131	215,515	20.7

Municipalities in Delaware (Included in Districts)

Municipality	1950 Population	1940 Population	% Increase 1940-50
Bellefonte	1,472	2,593	-43.2
Bowers	284	328	-13.4
Camden	606	682	-11.1
Cheswold	292	232	25.9
Clayton	825	890	- 7.3
Delaware City	1,363	1,163	17.2
Dover	6,223	5,517	12.8
Ellendale	321	287	11.8
Elsmere	5,314	1,630	226.0
Felton	455	442	2.9
Frederica	675	645	4.7
Harrington	2,241	2,113	6.1
Houston	332	296	12.2
Kenton	211	233	- 9.4
Leipsic	253	210	20.5
Lewes	2,904	2,246	29.3
Little Creek	266	242	9.9
Magnolia	207	218	- 5.0
Middletown	1,755	1,529	14.8
Milford	5,179	4,214	22.9
Milton	1,321	1,198	10.3
Newark	6,731	4,502	49.5
New Castle	5,396	4,414	22.2
Newport	1,171	987	18.6
Odessa	467	391	19.4
Port Penn	-	271	-
St. Georges	-	339	-
Slaughter Beach	85	46	84.6
Smyrna	2,346	1,870	25.5
Townsend	441	544	-18.9
Viola	134	113	18.6
Wilmington	110,356	112,504	- 1.9
Woodside	157	189	-16.9
Wyoming	911	870	4.7

* Estimated

APPENDIX B (Cont.)

Place	1950 Population	1940 Population	% Increase 1940-50
NEW JERSEY			
Atlantic Co.			
Buena Vista Twp. (33%)	702	655	-
Total-Atlantic Co. in Basin	702	655	-
Cape May Co.			
Cape May City	3,607	2,583	39.6
Cape May Point Borough	198	126	57.1
Dennis Twp. (50%)	990	938	5.5
Lower Twp. (50%)	1,368	846	61.7
Middle Twp. (50%)	2,300	1,944	18.3
West Cape May Borough	897	934	- 4.1
Woodbine Borough	2,417	2,111	14.5
Total-Cape May Co. in Basin	11,777	9,482	24.2
Cumberland Co.			
Bridgeton City	18,378	15,992	14.9
Commercial Twp.	3,238	2,822	14.7
Deerfield Twp.	1,758	1,483	18.5
Downe Twp.	1,786	1,546	15.5
Fairfield Twp.	2,932	1,977	48.3
Greenwich Twp.	966	929	4.0
Hopewell Twp.	2,460	2,048	20.1
Landis Twp.	21,418	16,525	29.6
Lawrence Twp.	2,044	1,754	16.5
Maurice River Twp. (80%)	2,265	1,810	25.3
Millville City	16,041	14,806	8.3
Shiloh Borough	427	387	9.4
Stow Creek Twp.	957	720	32.9
Upper Deerfield Twp.	5,203	2,020	157.6
Vineland Borough	8,155	7,914	3.0
Total-Cumberland Co. in Basin	88,028	72,733	21.0
Gloucester Co.			
Clayton Borough	3,023	2,320	30.3
Elk Twp. (67%)	1,390	1,110	25.2
Franklin Twp. (50%)	2,528	1,732	46.0
Logan Twp. (10%)	222	163	36.2
Newfield Borough	1,010	889	13.6
South Harrison Twp. (33%)	289	229	26.2
Woolwich Twp. (33%)	448	398	12.6
Total-Gloucester Co. in Basin	8,910	6,841	30.2

APPENDIX B (Cont.)

Place	1950 Population	1940 Population	% Increase 1940-50
Salem Co.			
Alloway Twp.	1,792	1,705	5.1
Elmer Borough	1,460	1,344	8.6
Elsinboro Twp.	674	663	1.7
Lower Alloways Creek Twp.	1,307	1,124	16.3
Lower Penns Neck Twp.	7,376	5,113	44.3
Mannington Twp.	1,686	1,656	1.8
Oldmans Twp.	1,657	1,722	- 3.8
Penns Grove Twp.	6,669	6,488	2.8
Pilesgrove Twp.	1,942	1,614	20.3
Pittsgrove Twp.	2,808	2,157	30.2
Quinton Twp.	1,821	1,313	38.7
Salem City	9,050	8,618	5.0
Upper Penns Neck Twp.	6,717	4,805	39.8
Upper Pittsgrove Twp.	2,204	1,925	14.5
Woodstown Borough	2,345	2,027	15.7
Total-Salem Co. in Basin	49,508	42,274	17.3
TOTAL - NEW JERSEY in Basin	158,925	131,985	20.4
PENNSYLVANIA			
Chester Co.			
Avondale Borough	941	754	24.8
Birmingham Twp. (75%)	322	288	11.8
Caln Twp.	5,779	3,661	57.9
Coatesville City	13,825	14,006	-12.9
Downington Borough	4,948	4,645	6.5
East Bradford Twp.	1,187	1,033	14.9
East Brandywine Twp.	1,108	913	21.4
East Caln Twp.	403	315	27.9
East Fallowfield Twp.	1,795	1,542	16.4
East Marlborough Twp.	1,868	1,600	16.8
East Nantmeal Twp. (20%)	133	110	20.9
East Whiteland Twp. (10%)	174	129	34.9
Franklin Twp. (75%)	500	491	1.8
Highland Twp. (80%)	723	662	9.2
Honey Brook Borough	864	766	12.8
Kennett Twp.	2,145	1,767	21.4
Kennett Square Borough	3,699	3,375	9.6
London Britain Twp.	559	462	21.0
Londonberry Twp. (75%)	446	359	24.2
London Grove Twp.	1,844	1,666	10.7
Modena Borough	824	625	31.8
New Garden Twp.	3,027	2,716	11.4
Newlin Twp.	957	984	- 2.8
Honey Brook Twp. (90%)	1,135	1,054	7.7

APPENDIX B (Cont.)

Place	1950 Population	1940 Population	% Increase 1940-50
New London Twp. (25%)	165	156	5.8
Parkesburg Borough	2,611	2,288	14.1
Penn Twp. (60%)	423	353	19.8
Pennsbury Twp.	686	660	3.9
Pocopson Twp.	475	513	- 7.4
Sadsbury Twp.	1,502	1,226	22.5
South Coatesville Borough	1,996	1,604	24.4
Upper Uwchlan Twp. (50%)	380	345	10.1
Uwchlan Twp. (50%)	380	300	21.1
Valley Twp.	3,148	2,663	18.2
Wallace Twp.	771	597	29.1
West Bradford Twp.	1,530	1,367	11.9
West Brandywine Twp.	1,122	776	44.6
West Caln Twp. (75%)	1,114	910	22.4
West Chester Borough (50%)	7,584	6,645	14.1
West Fallowfield Twp.(10%)	107	93	15.1
West Goshen Twp. (25%)	885	614	44.1
West Grove Borough	1,521	1,357	12.1
West Marlborough Twp.	786	882	-10.9
West Nantmeal Twp. (80%)	645	452	42.7
West Sadsbury Twp. (5%)	40	32	25.0
Westtown Twp. (5%)	50	45	11.1
Total-Chester Co. in Basin	77,127	67,801	13.8
Delaware Co.			
Birmingham Twp. (50%)	418	402	4.0
Total-Delaware Co. in Basin	418	402	-
Lancaster Co.			
Salisbury Twp. (10%)	393	358	9.8
Total-Lancaster Co. in Basin	393	358	-
TOTAL - PENNSYLVANIA in Basin	77,938	68,561	13.7
MARYLAND			
Cecil Co.			
District #4 - Fair Hill (10%)	204	176	13.7
TOTAL - MARYLAND in Basin	204	176	-
TOTAL POPULATION IN ZONE 4	497,198	416,237	19.5

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Delaware											
Bellevue (a)	x			P	(150)	7,000	350,000	x	x		Bellevue Lake
Camden (b)		x		M	606	1,230	140,000			x	
Clayton		x		M	825	865	100,000			x	
Delaware City		x		P	1,363	960	50,000			x	
Dover		x		M	6,223	5,700	1,200,000			x	
Elsmere		x		P	5,314	5,300	650,000			x	
Felton		x		M	455	240	25,000			x	
Frederica		x		P	675	600	30,000			x	
Harrington		x		M	2,241	1,880	375,000			x	
Lewes		x		M	2,904	2,130	600,000			x	Spray aeration
Magnolia		x		M	207	140	10,000			x	
Middletown		x		M	1,755	1,440	80,000	x	x		
Milford		x		M	5,179	3,330	600,000		x		
Milton		x		M	1,321	980	70,000			x	

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Newark		x		M	6,731	4,950	400,000			x	
New Castle		x		M	5,396	4,200	300,000	x	x		
New Castle County Airbase		x		P	(2,000)	2,000	100,000	x	x		
Newport		x		M	1,171	890	70,000			x	
Richardson Park (c)		x		P	(1,600)	(1,600)	2,250,000			x	Two well supplies
Smyrna		x		M	2,346	1,750	250,000			x	
Townsend		x		M	441	375	25,000			x	
Wilmington (d)	x			M	110,356	122,000	14,300,000	x	x		Two supplies from Brandywine River (imp.)
Brandywine Sanitorium	x			M	(500)	500	8,000	x	x		Red Clay Creek
Delaware Colony		x		M	(800)	800	10,000			x	
Delaware State Hospital		x		M	(1,500)	1,500	210,000	x	x		
Delaware State College		x		M	(500)	400	6,000			x	

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Delaware State Welfare Home		x		M	(400)	400	25,000			x	
Delaware Water Co.-Stanton Plant (e)	x			P		10,000)	8,000,000)				
						)	)	x	x		White Clay Creek
Delaware Water Co.-Christina Plant (e)	x			P		)	)	x	x		Christina River
New Jersey											
Bridgeton	x			M	18,378)	15,500)	2,480,000)	x	x		Sunset Lake 1 of
		x		M	)	)	)		x		2 wells chlor.
		x		P	)	)	)			x	Emergency supply
Cape May (f)		x		M	3,607	3,710	700,000		x		
Cape May Point (g)		x		M	198	265	39,000		x		
Clayton		x		M	2,500	2,500	60,000		x		
Elmer		x		P	1,460	1,200	54,000			x	

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Landes Twp. Malaga Section		x		P	-	W-100 S-650	-			x	
Landes Twp. N. Vineland Section		x		P	-	210	-			x	
Lower Penns Neck Twp.-		x		M	7,376	5,000	265,000	x	x		
Lower Penns Neck Twp. Deepwater Village		x		P	-	300	367,000		x		
Maurice River Twp.		x		P	2,834	S-150	8,000		x		
Millville	x			P	16,041	15,000	1,500,000	x	x		Union Lake
		x		M	)	)	)			x	
Newfield		x		M	1,010	1,000	50,000			x	
Penns Grove (h)		x		P	6,669	9,150	400,000	x	x		Ranney Collector; Also enlarging well
Salem (i)	x			M	9,050	8,700	500,000 E	x	x		Laurel Lake and Elkinton Pond
		x		M	)	)	)		x		
		x		M	)	)	46,000			x	

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Upper Deerfield Twp.		x		P	5,203	200	W-2,500,000 S-8,500,000			x	
Upper Penns Neck Twp. Carneys Point Section		x		P	-	1,850	144,000		x		
Upper Penns Neck Twp. Deepwater Section		x		P	-	-	-		x		
Vineland (j)		x		P	8,155)	12,000)	2,500,000			x	
		x		M	)	)	1,150,000			x	
Woodbine		x		P	2,417	2,110	71,000	x			Aeration
Pennsylvania											
Avondale			x	P	941	750	60,000		x		
Coatesville	x			M	)	)	)	x	x		Brandywine Creek
(k)	x			M	13,825)	19,000)	2,500,000)	x	x		Stillhouse Run
Downingtown	x			M	4,948	5,000	620,000	x	x		Brandywine Creek
Honeybrook		x	x	M	864	765	40,000			x	
Kennett Square	x			M	3,699	3,375	350,000	x	x		Brandywine Creek

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Municipality	Source of Supply: Stream	Well	Spring	Owner	Population 1950	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.	Type of Treatment: Filt.	Chlorin.	None	Remarks
Parkesburg	x	x	x	P	2,611	3,300	100,000		x		
West Grove		x		P	1,521	1,360	100,000			x	
Embreeville State Hospital	x			P	-	550	70,000	x	x		Brandywine Creek

Notes

(a) Bellevue serves Bellevue, Bellefonte, Claymont, Gwinhurst, Holly Oak and Silverside.
(b) Camden serves Camden and Wyoming.
(c) Richardson Park serves Richardson Park and suburban areas adjacent to Wilmington and Richardson Park.
(d) Wilmington serves Westover Hills, Wilmington and other areas.
(e) Delaware Water Co. serves Newark (part), Brookside Park Station, Wilmington Suburban Water Co., Pennsylvania Railroad, duPont Edgemoor plant, and other industries.
(f) Cape May serves Cape May, Lower Twp. (part), South Cape May, West Cape May.
(g) Cape May Point serves Cape May Point, Lower Twp. (part).
(h) Penns Grove serves Pedricktown, Penns Grove, Upper Penns Neck Twp. - Penns Neck vicinity.
(i) Salem serves Quinton Twp. and Salem.
(j) Vineland serves Landis Twp. (part) and Vineland.
(k) Coatesville serves Coatesville and South Coatesville.

APPENDIX C

DELAWARE RIVER BASIN - ZONE 4

Public Water Supply Data

Owner-Treatment	Source of Supply: Stream	Well	Spring	Number of Water Systems	Estimated Population Served 1949	Average Plant Output 1949, G.P.D.
Delaware						
Municipal						
Filtration	2	3	-	5	129,640	14,898,000
Chlorination Only	-	1	-	1	3,330	600,000
None	-	15	-	15	22,730	3,306,000
Private						
Filtration	3	1	-	4	19,000	8,450,000
Chlorination Only	-	-	-	-	-	-
None	-	4	-	4	28,470	2,980,000
TOTAL- DELAWARE	5	24	-	29	203,170	30,234,000
New Jersey						
Municipal						
Filtration	2	1	-	3	229,200	3,245,000
Chlorination Only	-	5	-	5	6,475	799,000
None	-	4	-	4	1,000	1,246,000
Private						
Filtration	1	1	-	2	24,150	1,900,000
Chlorination Only	-	5	-	5	4,410	590,000
None	-	6	-	6	13,710	5,054,000
TOTAL - NEW JERSEY	3	22	-	25	78,945	12,834,000
Pennsylvania						
Municipal						
Filtration	4	-	-	4	27,375	3,470,000
Chlorination Only	-	-	-	-	-	-
None	-	1	1	2	765	40,000
Private						
Filtration	1	-	-	1	550	70,000
Chlorination Only	1	1	2	4	4,050	160,000
None	-	1	-	1	1,360	100,000
TOTAL - PENNSYLVANIA	6	3	3	12	34,100	3,840,000
Total Basin	14	49	3	66	316,215	46,908,000

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